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## Environmental and Economic Review of Crop Protection and Pesticide Use in Ethiopia

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**Delivery Order No. 33**
**Contract No. DHR-5555-Q-00-1085-00**

# Environmental and Economic Review of Crop Protection and Pesticide Use in Ethiopia

**by**

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**November 1995**

Prepared for

U.S. Agency for International Development/Ethiopia

by

Environmental and Natural Resources Policy and Training (EPAT) Project
Applied Research, Technical Assistance and Training
Winrock International Environmental Alliance
Arlington, Virginia, U.S.A.

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## Acronyms

| | |
|---|---|
| ACDI | Agricultural Cooperative Development International |
| AELGA | African Emergency Locust/Grasshopper Assistance |
| AERC | African Economic Research Consortium |
| AETSE | Agricultural Equipment and Technical Services Enterprise |
| AISCO | Agricultural Inputs Supply Corporation (former input marketing parastatal) |
| AISE | Agricultural Inputs and Supply Enterprise (formerly AISCO) |
| c&f | cost of freight (import cost at home port including freight) |
| cif | cost of insurance and freight (import cost at home port including insurance and freight) |
| $CO_2$ | Carbon dioxide |
| CIMMYT | International Center for Maize and Wheat Development |
| cpi | consumer price index |
| DCM | Development of Competitive Markets Program (USAID/Ethiopia) |
| DLCO | Desert Locust Control Organization |
| EGTE | Ethiopian Grain Trade Enterprise |
| EPAT | Environmental and Natural Resources Policy and Training Project |
| ERDA | Ethiopian Resources for Developing Agriculture |
| ESE | Ethiopian Seed Enterprise |
| EU | European Union |
| FAO | Food and Agricultural Organization of the United Nations |
| g | gram(s) |
| GOE | Government of Ethiopia |
| IAR | Institute for Agricultural Research |
| IFDC | International Fertilizer Development Center |
| IITA | International Institute for Tropical Agriculture |
| ILCA | International Livestock Center for Africa |
| ILRI | International Livestock Research Institute |
| IPM | Integrated pest management |
| kg | kilogram(s) |
| l | liter(s) |
| $LD_{50}$ | Median lethal dose: a concentration of a pesticide that kills 50 percent of test animals, usually rats, expressed in milligrams of pesticide per kilogram of body weight. |
| MCTD | Ministry of Coffee and Tea Development |
| MOA | Ministry of Agriculture |
| MOH | Ministry of Health |
| MSB | Maize stalk borer |
| MSFD | Ministry of State Farms Development |
| MSV | Maize streak virus |
| mt | metric ton(s) |
| NEP | New Economic Policy (structural adjustment program initiated in 1992) |
| NGO | Nongovernmental organization |



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| | |
|---|---|
| OP | Organophosphate pesticide |
| PIC | Prior Informed Consent (procedures under FAO's International Code of Conduct on the Distribution and Use of Pesticides |
| PRC | Pesticides Registration and Control (office) |
| Q | Quintal (100 kgs) |
| RUP | Restricted use pesticide (USEPA classification) |
| SEA | Supplemental environmental assessment |
| SG 2000 | Sasakawa Global 2000 |
| ULV | Ultralow volume (formulation) |
| UNIDO | United Nations Industrial Development Organization |
| USEPA | U.S. Environmental Protection Agency |
| WHO | World Health Organization (United Nations) |
| WP | Wettable powder |



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## Commonly Used Ethiopian Terms and Place Names

| | |
|---|---|
| E. Wellega | East Wellega (Oromia Region) the administrative zone in which the proposed ERDA production component of the project will start |
| *injera* | A pancake-like bread made from the flour of *teff* or other grains |
| Oromia | The region in which ERDA project interventions will concentrate |
| region | Administrative unit above zone level |
| W. Shoa | A high potential zone west of Addis Ababa |
| S. Shoa | A high potential zone south of Addis Ababa |
| *shilshalo* | Weeding technique using an ox plow |
| *teff* | A major staple grain used in preparation of *injera* |
| *woreda* | District |
| zone | Administrative unit above *woreda* level |

## Units of Measure

| | |
|---|---|
| quintal | 100 kg |
| birr | Unit of Ethiopian currency. Rate at time of this review, 6.28 birr/$1. |



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## Preface

This review is one of several analyses that USAID/Ethiopia has commissioned in support of its upcoming intervention, Ethiopian Resources for Developing Agriculture (ERDA). Other recently completed reports include Gordon (1995), Gordon, Abate, and Bedane (1995), and Abt Associates (1995).

The review provides an overview of pest management and pesticide use in Ethiopia. It places emphasis on pest issues for smallholder producers of maize and wheat as these represent a specific concern for ERDA. Sections 3 and 5 constitute a programmatic environmental assessment (PEA) of pesticide use under ERDA. Based on this PEA, an initial environmental examination (IEE) is being prepared.

The team wishes to thank Dr. Marty Hanratty, Ms. Meg Brown, and Dr. Tadele Selaisse of the USAID/Ethiopia's Agriculture and Natural Resource Office, Addis Ababa, for their guidance and periodic consultation. USAID staff were particularly generous in sharing scarce office space with the team. Mike Harvey and Peter Riley made time in busy schedules for discussion and provided key documents. Dr. Walter Knausenberger, Environmental Advisor to USAID's Bureau for Africa, gave an orientation to the team in the initial week of work.

In the Ethiopian government, Ato Fessehaye Derso of the Sholla Crop Protection Laboratory was an extremely helpful in providing the team with insights into pesticide regulation and enforcement. Ato Belisa of the Agricultural Inputs Supply Enterprise (AISE), formerly the Agricultural Inputs Supply Corporation (AISCO) assisted greatly with provision of price and supply data. Staff of extension offices in Nekemte (East Wellega zone) and Awassa (Sidamo zone) received the team on field trips and were helpful in providing contacts at the district level.

In the private sector, Amalgamated Enterprises, Ltd., and AgrEvo are thanked for providing access to data and for helpful discussions on the current business and policy environment. Many representatives of small businesses involved in pesticide sales were gracious in consenting to be interviewed during the team's three field trips.

After the completion of the team's draft report, representatives of USAID's Bureau for Africa and its Regional Economic Development Support Office for East and Southern Africa reviewed and discussed the report with members of the team. These discussions resulted in some changes in the draft report (especially in section 5), but in all instances the team member responsible for the pertinent sections reviewed and accepted the proposed changes.



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## Foreword

This report's purpose is to assist USAID/Ethiopia as it assesses the environmental implications of efforts to stimulate agricultural production in Ethiopia, a low-income, food-deficit country. USAID's involvement in Ethiopia is based on a fundamental premise, namely that increases in agricultural production are an absolute priority for economic improvement as well as for continued social and political stability. In addition to its effort to increase agricultural productivity, USAID also has an interest in ensuring that its activities are sustainable and environmentally sound.

For these reasons USAID/Ethiopia engaged the Environmental and Natural Resources Policy and Training Project to examine how efforts to increase agricultural production might affect the use of pesticides in that country. Due to their inherently toxic nature, the use of most pesticides is problematic, and their unwanted side effects can be catastrophic when transported, stored, or used improperly. When used appropriately, however, particularly in the context of integrated pest management, pesticides can make a substantial contribution to improved productivity. This report addresses these issues, identifies how USAID's efforts might affect pesticide use, and then discusses how increased reliance on integrated pest management can be encouraged in Ethiopia.

The intended target audience, which includes the staff of USAID/Ethiopia, contractors responsible for the implementation of the mission's agricultural initiatives, and representatives of the Government of Ethiopia, should benefit considerably from this report. The test of that judgment will be reflected in USAID's contribution to prudent environmental management in Ethiopia.

The cost of preparing and printing the report is estimated to be about $3,000.

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## Executive Summary

This report provides a general review of pesticides and pest management in Ethiopian agriculture. It considers both environmental and economic aspects of the pest problem and pest-management options and provides a general analysis of pest-management options, pesticide use, regulation, and marketing in Ethiopian agriculture (sections 2 to 4). Particular emphasis is placed on crops and locations affected by USAID's intervention, Ethiopian Resources for Developing Agriculture (ERDA). The main crops involved in ERDA are maize and wheat, and the initial location for project activities is the East Wellega Zone, in Oromia Region.

In addition to this general review, a more specific task is undertaken: determination of likely USAID project involvement with pesticides, and consideration of mitigatory measures that may be required to satisfy USAID's Environmental Procedures. Analysis in section 5 is to be used as background for an initial environmental examination (IEE) of ERDA.

The main findings of the review and the preparatory work for the IEE include the following:

- Pesticide use on small farms is extremely limited. Most imports have in the past been directed to state farms for use on cotton and cereals, but with the restructuring of state farms, overall demand is declining. Smallholder demand remains limited and narrowly focused on herbicides (for use on wheat and *teff*) in more intensified areas such as Shoa and Arsi zones.

- Smallholders use traditional nonchemical pest-management techniques, which have in the past provided some measure of protection against the main field and storage pests for cereals: insects, weeds, diseases, and rodents. These "traditional integrated pest management" (IPM) methods, which include cultural practices and mechanical controls, should not be displaced or eroded unless better alternatives are shown to exist. It may be possible to improve these practices still further through management methods that research on IPM suggests.

- The volume of field and storage losses due to pests on small farms in Ethiopia is not known with any accuracy. Loss figures from research experiments of 30 percent to 50 percent are exaggerated. Such experiments typically take place on-station and do not represent actual practices or pest pressures on small farms. At best, these figures indicate levels of loss that would be experienced in extreme, worst-case situations.

- Linkages between research on pesticides' effectiveness and resulting extension recommendations could be greatly improved. The team has identified one approved maize insecticide, Marshal (common name: carbosulfan), for which no research trials have been conducted in Ethiopia.

- A 1990 decree provides the legal basis for the regulation of pesticides in Ethiopia. The decree is currently being strengthened through the work of a National Task Force. The Government of Ethiopia's capacity for pesticide regulation, monitoring, and enforcement is



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extremely weak, and linkages between national institutions and regions need to be articulated and strengthened. In addition, although the Ministry of Agriculture (MOA) has a small analytical laboratory that could be used in support of a quality control program for pesticides, it lacks capabilities to analyze pesticide residues.

- Important contrasts and similarities exist between reform experiences in the fertilizer and pesticide subsectors. First, the private sector's response to liberalization has been slow in both sectors, due to government policies as well as limitations inherent in markets (see section 4.3.2). Second, the reform of cooperatives has affected demand for fertilizer among smallholders. Pesticide demand has not been affected, because pesticides have never been a focus of cooperatives' efforts to supply inputs. Reforms affecting state farms have lowered substantially overall demand for pesticides, but this has not affected small-scale farmers. Third, some government intervention to regulate pesticide and fertilizer marketing is justified. Requirements for regulation for pesticides are greater due to human and environmental costs.

- The public and private sectors are not adequate in their management of pesticides and the physical capacity they have for handling and storage of pesticides. In the private sector, pesticide handling is particularly problematic at retail levels. Small-scale traders' repackaging and adulteration is common, due in part to package sizes that are too large and therefore must be broken down. Labels are in English rather than a local language. Untrained staff in general stores, who are not familiar with the proper handling and storage methods, typically have responsibility for pesticides.

- ERDA's efforts to develop sustainable input supply systems will assist the emergence of efficient input marketing enterprises dealing in a wide range of agricultural inputs. In East Wellega, such enterprises may not deal in pesticides soon, but efforts to develop markets still have indirect relevance for pesticide marketing. Specifically, when such trade does emerge, general development of input supply systems will provide a stronger basis for efficient pesticide delivery and regulation.

- Analysis in section 4 shows that the prices of the Agricultural Inputs and Supply Enterprise (AISE) are below what the market would charge, indicating the presence of implicit subsidies. Other hidden subsidies may well exist for AISE or large private distributors.

- There exist inherent difficulties in monitoring pesticide use and safety for smallholding farmers and small traders. Small farmers using pesticides in maize and wheat areas do not normally use protective equipment during application. Special equipment, such as goggles, respirators, and rubber gloves and boots are not available in the project area or potential expansion zones. Most such equipment would be prohibitively expensive for small farmers in any case. In addition, the infrastructure is poor for dealing with human poisoning or the buildup of residues in soil and water.

- Specific ERDA activities involving the actual or potential use or handling of pesticides include the following:



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(1) Provision of the East Wellega zonal agricultural office with two pickup trucks, which might be used to transport the insecticide Marshal (about 500 kg in a single trip) to districts in which the nongovernmental organization (NGO) Sasakawa Global 2000 (SG 2000) operates demonstration plots;

(2) Provision of small amounts of pesticides for use on experimental trial plots at the Bako Research Center; and

(3) Provision of pesticide inputs to extension demonstration plots in wheat expansion zones (year five of the project).

It is not expected that pesticides will be supplied to demonstration plots in the five East Wellega districts that ERDA supports. In two districts in which SG 2000 operates (and which ERDA supports indirectly), USAID will have no involvement in input provision for demonstration plots, and no involvement with pesticides.

Most if not all of the following pest-management recommendations can be accommodated within existing, planned ERDA activities. The scale of suggested activities should be modest. This reflects the relatively small role that pest-management measures have in extension packages, and the general uncertainty at the research level surrounding the importance of pest problems and the most effective control measures.

**1. Promote IPM as National Policy**

- ERDA should support the adoption of IPM as a country-wide policy. A coordinated approach that involves both the extension and research systems is required. Policy dialogue with the Ministry of Agriculture will be necessary in order to develop a more consistent policy on pesticides that promotes and demonstrates chemicals only when research has shown a specific one to be effective and economical as opposed to the use of nonchemical alternatives. Wherever possible, ERDA should support the validation and promotion of nonchemical alternatives for both field and stored grain pests.

**2. Support Improved Pesticide Regulation**

- Through its policy component, ERDA should seek greater government support and commitment of resources to strengthen the implementation of the 1990 special pesticide decree and the Ministry of Agriculture's capacity to regulate pesticides, both at the central and regional levels. One possible conditionality would be a requirement that revenues from the registration of pesticides accrue to the Shola Plant Protection Laboratory.

**3. Support Research and Extension of IPM Approaches**

- ERDA should support adaptive research in IPM at Bako Research Center and in any expansion zones (e.g., Kulumsa Research Center for wheat). Several IPM approaches have been



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developed but need to be tested, adapted to farm conditions in different localities, and developed into location-specific recommendations. These activities are essential for the refinement of extension packages and also require feedback from extensionists.

- The extension system should present farmers with IPM alternatives in its demonstration plots. It should modify and improve the SG 2000 full-package demonstration approach into a partial package approach. In East Wellega this could involve demonstration of alternative plots with no pesticides, plots demonstrating disease-resistant composite seeds or landraces, and other combinations of package elements.

### 4. Train and Organize Input Dealers in Marketing and Safe Handling

- Where pesticide use is relatively well established, as in wheat zones, ERDA should incorporate training and technical assistance to farmers and input dealers in the safe handling and appropriate application of pesticides. Limited training of farmers is required in East Wellega due to the current low level of use.

- ERDA workshops should train input dealers in the business and technical aspects of pesticide handling and storage. Workshops can also support establishment of associations of input dealers. Workshops should be used to help identify and train local distribution networks and link them with suppliers in Addis Ababa. Finally, the workshops should be used to identify constraints on private trade that arise from existing regulations or their inefficient enforcement. Measures to eliminate constraints should start with discussions with regional and zonal officials, who should attend workshops, and if necessary extend to policy conditionality.

- The proposed SG 2000 Input Market Development Project should, in any anticipated activities related to pest management, focus efforts on improving traders' knowledge of proper pesticide handling, storage, and application. The project should also give emphasis to activities that will increase the supply and marketing of IPM technologies, in cooperation with the Bako Rural Technology Center. Finally, the project should explore the possible role of input businesses as financial intermediaries and develop interventions that can, to the extent possible, assist this.

### 5. Charge for the Full Cost of Pesticides

- Subsidies to the AISE and state farms should be eliminated as part of ERDA's policy conditionality. As a competitive enterprise, the AISE should no longer have free use of the MOA's facilities or services or preferential access to cheap credit. It should be charged for fixed assets (including vehicles) inherited from the Ethiopian government. The AISE should also eliminate the implicit subsidies that arise from its practice of pan-territorial and pan-seasonal pricing.

- ERDA should consider means to reduce and eventually eliminate distribution of subsidized chemicals for control of migratory pests.



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## 6. Monitor Pest Management and Pesticide Use

- Responsibilities for monitoring project safety should be assigned to the research team at Bako Research Center. One individual, with special expertise in pest and pesticide management at the Bako Station, should be responsible for monitoring pesticide use in the project's implementation areas.

- Monitoring and evaluation of project impact will occur through the Agricultural Economics/Farming Systems Unit at Bako. Planned baseline and follow-up surveys conducted through this unit should be used to monitor pest management and pesticide use at the farm level. This will include monitoring of the possible breakdown of traditional farming systems and pest-management practices that could occur with intensification.

- Data collection supported through the Central Statistical Authority should be used, where possible, to monitor pest management and pesticide use on a broader geographic scale. As with the above monitoring and evaluation surveys, monitoring should be limited to a few essential indicators in order to minimize data requirements.



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## 1.0 The Report's Scope and Aim

This review has two essential tasks. The first is to conduct an overview of pest-management options and pesticide use in Ethiopia, with emphasis on crops and locations that will be addressed in USAID's Ethiopian Resources in Developing Agriculture (ERDA). The second task is more limited, namely "to determine the extent to which applicable programs of the Mission do, or might, involve the use of pesticides." ERDA is the main USAID program for which pesticide involvement is considered, but other interventions are examined as well (see Annex 1).

ERDA is a $70 million, seven-year intervention slated to begin in 1996. It aims to assist intensification of staple grain production in Ethiopia through project and policy interventions. The project intervention, which accounts for $35 million of the total allocation, has three main components: a maize/wheat production component, a capacity-building component focusing on improved policy analysis, and a component aimed at improving data collection in agriculture.

Pesticide and pest-management issues arise primarily in connection with ERDA's production component. This $11 million project will intensify smallholder maize production in East Wellega and maize and wheat production in two expansion zones to be identified at a later stage. Zones of good agroclimatic potential are chosen for project focus because current extension technology packages promoted by the Ministry of Agriculture (MOA) and the nongovernmental organization (NGO) Sasakawa Global 2000 (SG 2000) in these areas have been shown to be particularly productive and profitable.[1]

Project activities will focus on improvement in the private sector's marketing of package inputs, especially fertilizer and seeds, and will provide support to research and extension services to refine current extension packages, thereby broadening the options offered to farmers. As will be shown in section 2, pesticide use is extremely low in Ethiopia's smallholder sector. It is virtually unknown in East Wellega, the initial project zone. While the MOA includes pesticides in its general recommendations to farmers, it does not promote them in East Wellega through its demonstration plots, nor does it promote them in general. SG 2000 does promote use of Marshal in its demonstration plots in East Wellega, but Marshal is not available on the market.

Team members for this consultancy included Dr. Tsedeke Abate (IPM specialist and entomologist), Dr. Angel Chiri (environmental protection specialist, entomologist), and Dr. Henry Gordon (team leader, economist).[2] The consultancy was conducted from the end of the second week of August to the end of the second week of September 1995. It involved three field trips,

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[1] See Gordon, Abate, and Bedane (1995) and Agridec (1995) for further information on ERDA's crop and area selection approach and for details on the current extension technology packages.

[2] Dr. Tsedeke Abate has been selected as 1995 African Fellow of USAID's Bureau for Africa.



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one to Arsi administrative zone, one to East Wellega zone, and one to Sidamo zone. See Figure 1.1.

The team recognized the need to synthesize the available research on pest management and pesticides in Ethiopia. The term "pests" as used in this review is defined to cover insects, diseases, weeds, and animals. Two literature reviews were commissioned, one on plant diseases and one on weeds, to complement the team's work. Dr. Habtu Assefa of the Institute of Agricultural Research (IAR) reviewed the literature on plant diseases; Ms. Y. Chiche of IAR conducted the review on weeds. The literature on insect management in Ethiopia is well known to Dr. Abate, so a separate literature review was not required for insect pests.

The team collected data from and completed interviews with a wide range of organizations and individuals. Those interviewed included government regulators, pest-management researchers, extension staff, input dealers in the private sector, donor organizations involved with pesticide donations, selected NGOs, and government parastatals dealing with pesticides. Government staff and private firms were consulted in Addis Ababa as well as in regional and zonal centers.[3] A list of individuals and organizations contacted is presented in Annex 10.

Section 2 provides an overview of pest problems and pest-management options in Ethiopian agriculture. It incorporates material from the two literature reviews and the team's own research. The regulatory environment for pesticides is assessed in section 3. The state of pesticide marketing and policy factors affecting the supply of and demand for pesticides are analyzed in section 4. Section 5 is self-contained and provides essential material for an IEE. The main findings and recommendations of the report are summarized in section 6.

## 1.1 Country Background

Ethiopia is a country of nearly one million square kilometers (km) extending between latitudes roughly 4°N and 15°N. The country has great agroecological diversity, ranging from below sea level to well over 3,000 meters above sea level (masl), thus ranging from desert climate (<500 masl) to alpine climate (>3,000 masl). On the basis of temperature and moisture regimes, the country can be divided into 18 agroecological zones and 62 subzones. Consequently, Ethiopia possesses a wide variety of plant and animal fauna, and for many of these species this is their original home.

Many food and cash crops are grown in Ethiopia. These include cereals (*teff*, sorghum, barley, maize, wheat, millet, oats), legumes (faba bean, field pea, chickpea, lentil, haricot bean, grasspea, soybean), oil seeds (niger seed, linseed, sesame, fenugreek, rapeseed, sunflower, groundnut), coffee, and cotton.

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[3] The chief administrative units in Ethiopia, moving from higher to lower levels of the hierarchy, are regions, zones, and districts (*woredas*).



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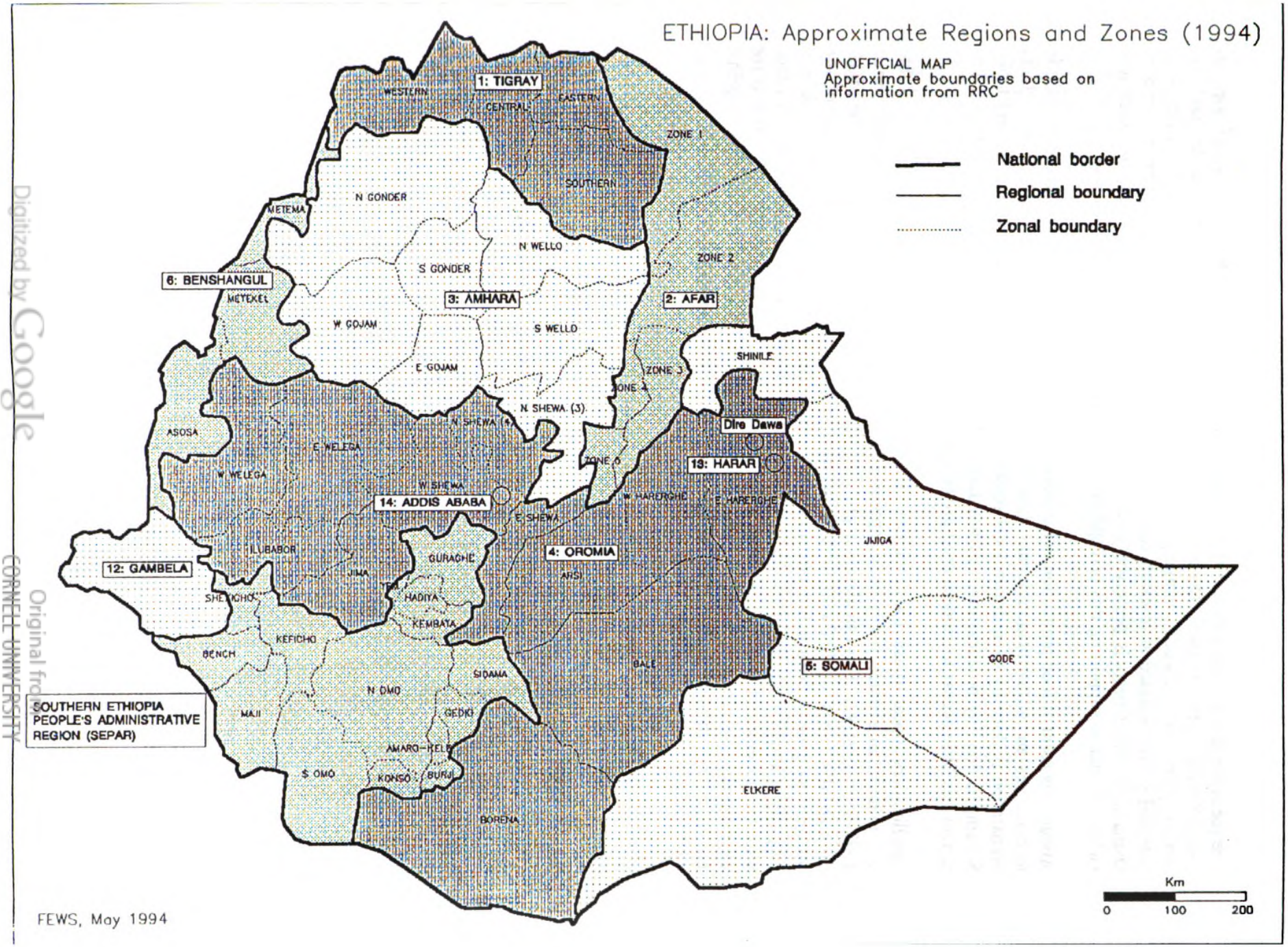


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The mean annual cultivated area of food crops for the period 1979-80 through 1986-87 was just over 5.8 million hectares (ha). The average yield for the same period was 10.9 quintals/ha (with cereals, pulses, and oilseeds averaging 11.1, 7.8 and 4.9 q/ha, respectively).[4] Compared with potential yields obtained at research centers and on-farm trials, such yields are extremely low. Damage by insect pests is perceived to be one of the major factors responsible for such low yields. Evidence supporting this perception is examined critically in later sections.

About 95 percent of food production in Ethiopia comes from the peasant sector, where production technologies are primarily traditional. Land holdings range between 0.5 and 3.0 ha. Land preparation is done by oxen-drawn local plow (*maresha*) or by manually operated hand tools. Seeding is done by broadcasting, and weeding is dependent on labor-intensive practices. The farmer has little access to modern crop-protection technologies.

Smallholders appear to use few pesticides. The team's estimates of per ha use, shown in Table 1.1, indicate an average yearly consumption .09 kg/ha by small-scale farmers over the period 1987-88 to 1991-92. This calculation is probably an overstatement. On the one hand, the MOA through AISCO has supplied state farms in the past, so some portion of the yearly average of 548 mt/year has gone to large public enterprises. On the other hand, and most important, the vast majority of smallholder pesticides supplied in the past were for treatment against migratory pests, with the government taking responsibility for transport and storage (through AISCO) and for application. Routine purchase of pesticides by small-scale farmers for treatment against nonmigratory (chronic) pests is thus far less than the .09 kg/ha indicated in Table 1.1.

[4] A quintal equals 100 kgs. Quintal will be abbreviated as 'q' in this report.



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**Table 1.1: Pesticide Use by the State and Smallholder Private Sector in Ethiopia** (averages of 1987-88 to 1991-92)

| Sector | area (000 ha) | kg/yr (000) | kg/ha/yr |
|---|---|---|---|
| State suppliers: | | | |
| MSFD | 180 | 1397 | 7.76 |
| MCTD | 30 | 40 | 1.47 |
| EGTE | na | 4 | na |
| Smallholder Suppliers: | | | |
| MOA (AISCO) | 5820 | 548 | .09 |
| National average | 6000 | 1993 | 0.33 |

MSFD = Ministry of State Farms Development; MCTD = former Ministry of Coffee and Tea Development; MOA (AISCO) = Ministry of Agriculture (Agricultural Inputs Supply Corporation); EGTE = Ethiopian Grain Trade Enterprise; note that AISCO's data reflect some distribution to state farms. In addition, these data include pesticides imported for use against migratory pests. na = not applicable.

Source: files of respective organizations.



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## 2.0 Crop Protection and the Agricultural Sector

Research on crop protection in Ethiopia started with the establishment of the agricultural technical schools at Jimma and at Ambo in the early 1950s, and at the Imperial Ethiopian College of Agriculture and Mechanical Arts at Alemaya (now Alemaya University of Agriculture). Concerted efforts to tackle agricultural pest problems started with the establishment of the Institute of Agricultural Research in 1966.

Initial efforts concentrated on the survey and identification of major pests and diseases on major crops and establishment of their economic importance. Control measures focused on screening and use of pesticides. Concerted research on IPM started toward the first quarter of the last decade. Such research included studies on cultural practices, host-plant resistance, biological control, and use of selective pesticides.

### 2.1 Nature and Magnitude of the Pest Problem

Insects, diseases, and weeds cause the most damage to crops. Rodents and wildlife (monkeys, baboons, etc.) are also important in many parts of Ethiopia. Weaver birds (*Quelea quelea*) have an important impact on sorghum, particularly in the country's rift valley regions.

In the initial ERDA project area of East Wellega, the chief problem pests for maize are insects, weeds, and diseases, in that order. For major wheat-growing areas, the main problems in order of priority are weeds, diseases, and insects. Diseases are becoming more important in improved varieties. These rankings may change because of intensification and introduction of new improved crop varieties encouraged by extension. This issue is discussed in later sections.

#### 2.1.1 Insect Pests

Insect pests in Ethiopia can be divided into two major categories: migratory and nonmigratory pests. The African armyworm and locusts are the most important migratory pests affecting cereals and grazing area.

Migratory pests

The African armyworm (*Spodoptera exempta*) and locusts (the desert locust *Schistocerca gregaria* and the African migratory locust *Locusta migratoria migratorioides*) can cause total crop loss during outbreak years. Large areas of land are treated with insecticides against these pests during outbreak seasons. For example, annual average hectarage (pesticides) for armyworm and locust campaigns are estimated at about 104,000 ha (124,000 kg) and more than 89,000 ha (nearly 93,000 kg), respectively (Tables 2.1 and 2.2).



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**Table 2.1: Land Area Treated and Pesticide Amounts Employed in Armyworm Campaigns in Ethiopia**

| Year | Area (ha) | Amount (l) | Amount (kg) | Tot. Amount |
|---|---|---|---|---|
| 1988 | 8,000 | 7,000 | 3,000 | **10,000** |
| 1989 | 80,000 | 98,000 | 94,000 | **192,000** |
| 1990 | 45,000 | 40,000 | 23,000 | **63,000** |
| 1992 | 54,000 | 10,000 | 6,500 | **16,500** |
| 1993 | 366,414 | 275,391 | 60,331 | **335,722** |
| 1994 | 70,000 | 83,000 | 24,000 | **107,000** |
| Total | 623,414 | 513,391 | 210,831 | 724,222 |
| Mean | **103,902** | **85,565** | **35,139** | **124,037** |

Source: Files of Shola Plant Protection Laboratory.

**Table 2.2: Land Area Treated and Pesticide Amounts Employed in Locust Campaigns in Ethiopia**

| Year | Area (ha) | Amount (l) | Amount (kg) | Tot. Amount |
|---|---|---|---|---|
| 1986 | 77,460 | 49,590 | 39,580 | 89,170 |
| 1987-88 | 110,750 | 47,358 | 28,790 | 76,148 |
| 1993 | 83,299 | 44,891 | 26,956 | 71,847 |
| Total | 271,509 | 141,839 | 95,326 | 237,165 |
| Mean | **90,503** | **47,280** | **31,775** | **79,055** |

Source: Files of Shola Plant Protection Laboratory.

The African armyworm is the major migratory pest of all cereals throughout Ethiopia during outbreak years. The desert locust is important in northern, northeastern, and north-central Ethiopia. The African migratory locust occurs in eastern and northeastern Ethiopia. Recent major outbreaks of armyworm and of the desert locust occurred during the 1989 and 1993-94, and 1986-89 and 1992-93 seasons, respectively. Locusts are not a major problem in East Wellega.

Control of migratory insects is dependent on accurate forecasting so that the necessary preparations for pesticide management can be arranged. Armyworm forecasting is achieved by establishing a network of light traps or pheromone traps at strategic locations across the country. Information on daily catches of the adult moth is transmitted to the Shola Plant Protection Laboratory (MOA) which in turn passes the information to the Desert Locust Control



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Organization of East Africa (DLCO-EA) for processing. The DLCO-EA issues warnings to the MOA if adult moth catches exceed threshold levels. To date, insecticide control, i.e., application of ground and aerial insecticides, such as malathion and fenitrothion, is the only practical means to control the armyworm.

The Government of Ethiopia, through the Shola Plant Protection Laboratory, is responsible for control of migratory pests. International and bilateral donor assistance is sought to cover the costs of insecticides and spraying equipment and for hiring spray aircraft. The DLCO-EA can also provide aircraft.

Nonmigratory pests

Stalk borers are the major pests of maize in most maize-producing regions of Ethiopia. Farmers and extension agents also perceive termites to be important maize pests in Wellega although research indicates that they do not cause significant yield loss.

Researchers recommend timely planting of maize and stalk drying for four to six weeks after harvest as the most important cultural management measures against maize stalk borer. Data the team collected on its trip to East Wellega also confirm that early planted maize suffers less infestation as compared to late planted maize. This was true not only for the stalk borer but also for diseases, such as turcicum leaf blight (see Table 2.3).

Insecticides have also been tested against stalk borer, and endosulfan (trade name: Thiodan), cypermethrin (Cymbush), and deltamethrin (Decis) are effective in managing the pest and minimizing yield losses. The MOA recommends the first two for smallholder use, but its demonstration plots do not include these chemicals.

The current maize package that SG 2000 promotes consists of improved seed, inorganic fertilizer, and insecticide seed treatment (with Marshal) for the control of stalk borers and perhaps soil-borne diseases. This insecticide has never been recommended in Ethiopia, and research on its effectiveness under Ethiopian conditions has not been conducted. Thus, there is no evidence that Marshal reduces yield losses or is profitable to use. Furthermore, its application requires specialized procedures.

The Russian wheat aphid is perhaps the most important insect wheat pest, especially under drier conditions found in the areas of North Shoa, Wello, and Tigrai. Researchers have identified effective insecticides, but use of host-plant resistance and cultural practices hold the best chance for the control of this insect in small-scale wheat production.



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**Table 2.3: Reaction of Maize Cultivars/hybrids to Maize Stalk Borer and Diseases in East Wellega** (sampled on August 21, 1995)

| Locality | Culti-var/ hybrid | Package | Plant-ing time | % Stalk Borer infestation. | % leaf blight infection |
|---|---|---|---|---|---|
| DIGGA | | | | | |
| Digga | BH660 | improved | late | 13.4 | negligible |
| Kejela | Local | local | early | 2.1 | negligible |
| GUTO DIGGA | | | | | |
| Fayinerra | BH140 | improved | late | 1.7 | >75 |
| Fayinerra | BH140 | improved | late | 8.0 | >75 |
| Fayinerra | Local | local | early | 2.7 | <10 |
| Gamachis | BH140 | improved | late | 5.0 | 100 |
| Gamachis | Local | local | early | 2.0 | negligible |

Note: percent infestation is based on a random sample of at least 100 maize plants for each cultivar/hybrid.

## Estimates of Crop Losses

Estimates of yield losses in cereals due to pests and diseases are given in Tables 2.4 to 2.6. Such estimates can be useful as indicators of the ability of a particular pest to inflict damage under the worst scenario, but these figures should be interpreted with great caution.

First, most yield estimates are obtained from on-station experiments and thus do not represent normal farm practice and cropping systems. Second, such experiments are conducted under artificial environments with increased pest pressure. For example, planting is synchronized with periods of peak pest populations. Susceptible cultivars are often employed as a test crop, and only monocropping, which is more susceptible to pest attack, is used. These experimental conditions fail to reflect a farmer's ingenuity and accumulated knowledge. The farmer is aware of when to plant. His or her chosen crop cultivars cannot be classified as susceptible, and most cropping systems under small-scale production are not monocrops either in time or in space.

Third, most if not all data are obtained from limited areas, and it is hazardous to extrapolate information gathered at a few locations to the national or regional situation. Finally, current estimates of yield loss do not consider the contribution of other factors such as vegetation diversity and edaphic and climatic conditions. Cereals in Ethiopia are grown under diverse vegetation conditions, which have profound effects on diseases and populations of arthropod pests and natural enemies.

The problems with Ethiopian crop-loss estimates described above apply equally to weeds, insects, and diseases. This should be kept in mind when examining Tables 2.4 to 2.6.



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**Table 2.4: Estimates of Preharvest Losses Due to Insect Pests in Cereals**

| Crop | Pest(s) | Loss (%) |
|---|---|---|
| maize | stalk borers | 0-100 |
| | termites | 27 |
| sorghum | stalk borers | 23-64 |
| barley | barley shoot fly | 33 |
| | Russian wheat aphid | 41-71 |
| wheat | Russian wheat aphid | 90-97 |
| *teff* | red *teff* worm | 33-45 |
| | grasshoppers | 1-48 |
| | Average | **31-61** |

Source: Abate (1995).

Storage Pests

A variety of insect and rodent (rats and mice) pests attack stored cereals in Ethiopia. The maize weevil (*Sitophilus zeamais*), followed by the Angoumois grain moth (*Sitotroga cerealella*), is perhaps the most important insect pest of stored maize. *Triboleum* spp. and *Ephestia cautella* are also reported to be of some economic importance. Major insects on stored wheat include the genera *Sitophilus*, *Ephestia*, *Rhizopertha*, *Sitotroga*, *Orizaphilus*, and *Triboleum*. Maize weevil and grain moth are the most important insects on maize and wheat. Loss in quality is more important than actual weight loss. Although infestations can reach up to 100 percent in six to eight months of storage, overall grain weight loss usually ranges between 5 to 10 percent.

Proper drying and improved storage structure are recommended practices for controlling storage insects. Few farmers use storage insecticides although this is being promoted (but not demonstrated) by extension at present. Effective insecticides include deltamethrin, pirimiphos methyl (Actellic), and methacrifos (Damfin). Researchers report encouraging results on the use of botanicals (such as neem seed powder) in the management of storage insects, and the team observed ongoing experiments on maize at Bako Research Center.

Farmers do not use rodenticides. The main control method is to guard fields to prevent damage by rodents and other animals.



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### 2.1.2 Plant Diseases[5]

The wide variation in climatic and agroecological conditions in Ethiopia favors the rapid development and growth of various plant diseases. Current records show that more than 468 diseases occur in most of the cultivated crops. About 20 percent of these are considered to be of major economic importance.

**Table 2.5: Estimates of Yield Loss Due to Diseases in Cereals**

| Crop | Disease | Loss (%) |
|---|---|---|
| Maize | leaf blight | 10-50 |
| | rust | 23-25 |
| | maize streak virus | up to 100 |
| Wheat | stripe rust | 27-100 |
| | septoria leaf blotch | 2-82 |
| | leaf rust | 63-75 |
| | stem rust | 61 |
| | eye-spot | 1-29 |
| | helminthosporium | 29 |
| Barley | scald | 21-67 |
| | bunt | 25-34 |
| | net blotch | 5 |
| | eye-spot | 1-9 |
| *Teff* | rust | 10-25 |
| | smudge | up to 50 |
| | Average | **19-49** |

Source: adapted from Assefa (1995).

Diseases of Maize

Maize is adapted to a wide range of environmental conditions in Ethiopia. At least 15 diseases infect the crop, of which the leaf blight (caused by *Helminthosporium turcicum*), the common rust (*Puccinia sorghi)*, and the maize streak virus (MSV) are the most prevalent and widely distributed.

[5] This section is based heavily on Assefa (1995).



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Management strategies for maize diseases include cultural, varietal, and chemical measures. Several cultural strategies are suggested, including adjustment of the sowing date, management of the density of plant populations, measures affecting the fertility of soils, and intercropping and tillage practices.

In general, the incidence of common rusts, leaf blight, and MSV is known to be less common in early rather than late planted maize. Studies at the Bako Research Center suggest, however, that the severity of rust and leaf blight is heavily influenced not only by the sowing date but also by crop variety. That is, diseases are more severe in some varieties when planted late and in other varieties when planted early. The severity of MSV increases with late planting.

High plant density favors rapid and severe development of leaf blight. Soil fertility improves the resistance level of a cultivar for leaf blight; rust population increases with the application of fertilizers. Mixed planting of maize with haricot beans results in a low incidence of both rust and leaf blight. By contrast, rust pressure increases when maize is intercropped with sorghum.

As regards host-plant resistance, most introduced lines are found susceptible to rust and leaf blight. Lines introduced by the International Center for Maize and Wheat Development (CIMMYT) and the International Institute for Tropical Agriculture (IITA) are susceptible to both diseases. Lines introduced from East Africa and those that are found locally seem to have a good level of resistance to both rust and leaf blight. Maize genotypes that possess highly resistant to moderately resistant traits to rust include KCB, HB32, EC573, KCE, UCB, H611, and H625.[6] A511, ICA, KCE, and H625 have some level of resistance to leaf blight, although the results vary from season to season. The IAR advises that maize varieties recommended for mid to high altitudes should possess resistant genes to rust and leaf blight. For areas such as Gambella, where conditions are most conducive to the development of MSV, breeding and pathology programs need to work together to develop materials resistant to MSV.

Chemical measures include both seed treatment and foliar sprays. Chemical trials in Arsi by the Chilalo Agricultural Development Unit and at Holetta (IAR) suggest that mancozeb and captan are effective against seedling diseases. In addition, chloranil is effective against *Diplodia* sp., carboxin against *Helminthosporum* spp., and organomercurials and thiram against *Fusarium* sp. and *Ustilago maydis*. Recent experimental results show that slurry seed treatment of Carboxin (Vitavax 200), Vitaflo 220, PP 450, Pangon, and Panctin are most effective in managing leaf blight.

Diseases of Wheat

Many diseases threaten wheat. To date, more than 37 diseases have been recorded of which 29 are fungal, three bacterial, one viral, and four are nematodes. Among these only a few--the rusts,

[6] Those starting with "H" are hybrids; the rest are composites.



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septoria, fusarium and smuts--are considered important. Environmental factors influence the appearance and behavior of these diseases.

The three rusts constantly damaging wheat crops are black (stem) rust (caused by *Puccinia graminies f. sp. tritici)*, brown (leaf) rust (*Puccinia recondita f. sp. tritici*,) and yellow (stripe) rust (*Puccinia striiformis f.sp. tritici)*. The rusts as a group are regarded as the most important diseases of wheat in Ethiopia.

Research on wheat disease concentrates on cultural methods, development of varietal resistance, and in some instances use of chemical measures. The sowing date is the most widely used cultural response to wheat diseases. Severities of wheat stem rust, leaf rust, and leaf blotch are known to vary with sowing dates. At Debre Zeit, stem rust was found more severe and yield losses highest on light soil in an early sown susceptible cultivar. In black soil, stem and leaf rusts are more severe on late sown crops. Thus at Debre Zeit the recommended date for sowing is between July 5 and 15.

Leaf rust at Kulumsa and septoria leaf blotch at Holetta and Sheno are severe on early sown (i.e., mid-June) susceptible varieties. Stripe rust is more serious and causes more damage on late sown wheat at Holetta and at Bekoji. The septoria attack decreases with delays in sowing date.

In 1970-71, leaf blotch reached epidemic proportions in early sown crops. Losses of 51 percent in yield and 42 percent of kernel weight occurred. Several studies done at Holetta suggest that disease severity and damage due to leaf diseases of wheat varies with the sowing date. Leaf blotch incidence and damage was higher on early sown than on late sown wheat. For stripe rust, damage was more severe on late sown wheat.

A study by the former Ministry of State Farms Development (MSFD) in Bale and Arsi highlands showed that yield losses due to stripe rust are highest (up to 44 percent and 30 percent for Mamba and RBC varieties) in early sown wheat. The loss due to leaf rust was 27 percent on the Enkoy variety in late sown crops.

Development of resistant varieties in wheat has followed two directions. The first focused on understanding the physiologic races of disease causing agents and the second on screening of genotypes and segregating materials against the major diseases of wheat.

Research on physiologic races concentrated primarily on the rust pathogens, namely stem, leaf, and stripe rust. Of the three rusts, the virulence spectrum of yellow rust in Ethiopia is among the broadest in the world.

In order to manage resistant cultivars properly in commercial farms and also to devise a proper gene deployment scheme, it is important and highly desirable that changes in the race population be detected periodically.



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The highly damaging nature of cereal rust, septoria blotch, and smut on wheat production in the highlands of Ethiopia has necessitated the development of a breeding program aimed at increasing disease resistance and screening of genotypes for these diseases. Evaluations of wheat varieties have been done mainly for rust and septoria blotch.

In breeding programs in western Europe, Ethiopian wheats have been used to promote resistance. In Ethiopia, a large number of wheat materials from national and international sources have been screened each season. Promising cultivars resistant to one or more diseases have been identified, and are used mostly in large commercial wheat farms. These include Mamba, Dereselign, Romany BC, Kanga, and Enkoy. A few cultivars such as K6106-9 and 7C-AN x INIA-B possess higher tolerance to septoria blotch. The improved variety Laketch has been found most susceptible to septoria blotch. Ethiopian durum wheat seems to be a good source of resistance to stem rust but lacks satisfactory resistance to leaf rust. Boohai is moderately resistant to stripe rust. Commercial bread-wheat varieties Enkoy and K6295-4A have remained moderately resistant to stripe rust for more than a decade. Advanced lines such as HAR 719, HAR 727, HAR 720, and HAR 604 are also potentially resistant to stripe rust.

For pathogens possessing a large number of strains (e.g., rusts in wheat), management strategies should focus on breeding for host-plant resistance. Past experience indicates that the more resistant a given variety is to the disease, the more severe the epidemic becomes when the resistance breaks down. This was illustrated by the wheat variety Dashen, which was highly resistant to yellow rust but was heavily damaged when another race of the disease attacked it after it was grown commercially for several years. It is thus essential that breeding for host-plant resistance be a continuous process.

Chemicals for the management of wheat diseases include both seed dressing and foliar sprays. benomyl, a systemic fungicide, is effective in the control of *Fusarium* head blight of wheat. Of several seed-dressing chemicals screened against *Fusarium*, *Septoria*, *Helminthosporium*, and *Tilletia*, the most effective products are Vitavax, Prochloraz, and Sportak.

Studies were also conducted to control septoria leaf blotch by spraying with fungicides. Copper oxychloride was found to reduce leaf blotch infection by 40 percent and increase the yield by about 18 percent. In other studies a number of fungicides including benomyl, carbendazim, fentin acetate (Breston 60), and captafol showed good efficacy.

Fungicides such as propiconazole (Tilt), triadimefon (Bayleton), and fenpropimorph showed high efficacy in the control of rusts at state farms at Arsi and Bale. Fungicide screening and rate-determination studies have been used to control stem, leaf, and yellow rust at Ambo. Propiconazole and flutriafol provided the most effective and profitable control of rust. Spray frequencies and cost-benefit analyses of the two best fungicides suggest that a surplus of 500 to 600 birr per ha can be obtained.

Among the five fungicides screened between 1985 and 1989 against leaf and stem rust at Debre Zeit, only propiconazole and triadimefon showed high efficacy. In 1986-87, six fungicides were



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tested for rust control on Dashen, Enkoy, and Laketch. Among those tested chlorothalonil (Bravo 500), propiconazole, and fentin acetate decreased disease and increased yield and seed weight. For septoria leaf blotch, fungicide spray resulted in a yield increase of up to 30 q/ha.

Generally, fungicide use is rare in Ethiopia, especially by the small peasant sector. Wheat diseases in Ethiopia account for about 6 percent of the total fungicide use. State farms use almost all of this to control stripe rust.

### 2.1.3 Weeds

Weeds are an important pest. Losses of cereal yield due to weeds are reported to range between 10 and 65 percent (Table 2.6). Research has indicated that various herbicides and mechanical methods are effective in control of weeds. Controlling weeds at an early stage, following germination, is effective for almost all crops. In general, there is a wider choice of herbicides for the control of broadleaf weeds than for grasses. Resource poor small-scale farmers use ox-weeding (*shilshalo*) techniques, and hand weeding with family labor.[7] As much as 30 percent of the total labor employed in food crop production can be used for weeding. Large commercialized farms predominantly use herbicides.

**Table 2.6: Estimates of Yield Loss Due to Weeds for Cereal Crops**

| Crop | Loss (%) |
|---|---|
| Maize | 25-58 |
| Sorghum | 30-42 |
| Wheat | 11-63 |
| Barley | 10-20 |
| *Teff* | 23-65 |
| Average | **20-49** |

Source: adapted from Chiche (1995).

Weeds of Maize

Of a wide array of weeds recorded on maize, the major ones include broad leaves (such as *Amaranthus*, *Bidens*, *Flaveria*, *Galinsoga*, *Guizotia*, *Tagetes*, *Commelina*, *Datura*, *Nicandra*),

[7] *Shilshalo* involves use of the plow to remove weeds by cutting rows when the crop is at knee-high stage. For documentation on labor use, see farm budgets in Gordon, Abate, and Bedane (1995), Appendix 6.



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grass weeds (such as *Cyperus*, *Cynodon*, *Digitaria*, *Eleusine*, *Setaria*, wild sorghum), and parasitic weeds (mainly the witch weed, *Striga* spp.).

Yield loss due to weed competition in maize for growth essentials can reach 58 percent, depending on the total weed density and the growth stage of the crop at which weeds are removed from the maize field. Results of research on the critical period of weeding indicate that weeds should be removed within four to six weeks of planting.

Methods to control weeds for maize include cultural measures and the use of herbicides. Herbicidal control is commonly used in the state farms whereas the vast majority of smallholders use cultural practices. Cultural methods to control weeds include preplanting tillage, hand weeding, mechanical weeding, and management of soil fertility.

Experiments were conducted on zero-tillage techniques, but smallholders have not adopted the technology, perhaps due to the high expense of herbicides, which the average farmer cannot afford.[8] The use of the moldboard plow is known to reduce weed density as compared with disk plow or the traditional *maresha*.

*Shilshalo* is widely practiced in most maize-growing regions of Ethiopia. It has the dual purpose of reducing the frequency of weeding and improving ridging, which reduces lodging.[9] The IAR's Agricultural Implements Research Center at Melkassa has recently developed a wheel-hoe weeder that can save up to 75 percent on labor hours and 13 oxen-hours per ha. Further modifications are being pursued to improve this device, particularly to reduce its weight.

In general, two hand weedings at 25-30 and 55-60 days after planting give adequate control of weeds in maize. *Shilshalo* often replaces the second weeding. Economic evaluations at Awassa show that hand weeding twice is more profitable than herbicide application with atrazine (Gesaprim), atrazine and metolachlor (Primagram), or Primextra. Another practice that has been suggested is band placement of fertilizer, which enhances early maize growth, thus improving the crop's ability to compete with weeds. Band placement is reported to be more effective than broadcasting.

As stated earlier, state farms practice chemical management of weeds. Research results indicate that atrazine is the best herbicide for controlling maize weeds in southern and western regions of Ethiopia. Research recommendations against *Rottboellia* include use of pendimethalin + atrazine (2 + 1 kg/ha). Other herbicide recommendations (such as from the IAR) are shown in Annex 2, Table 1. Hand pulling at flowering, nitrogen application to the soil, and intercropping are some of the recommended cultural practices that give some degree of control of *Striga*. No economical recommendations are available for herbicidal management of this weed.

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[8] Recommended doses are for 3.5 l/ha of glyphosate (Roundup), and 4.5 l/ha of paraquat.

[9] Lodging is the toppling over of plants.



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Weeds of Wheat

The major weed species that affect wheat production in Ethiopia include grasses (such as wild oats, *Bromus*, *Lolium*, etc.), and broadleaf weeds (*Amaranthus*, *Argemone*, *Convolvulus*, *Datura*, *Galinsoga*, *Galium*, *Guizotia*). The importance of grass weeds is reported to be on the increase presumably due to repeated application of herbicides against broadleaf weeds.

As with maize, most weed control for wheat in the peasant sector uses nonchemical means, although the review team's field surveys and interviews indicate increases in the use of herbicides, especially where improved varieties are used (e.g., Arsi). Hand weeding is by far the most means of cultural weed control in Ethiopia. Other methods include proper seed bed preparation, use of clean seed, seeding rate, minimum tillage, use of mechanical weeder, choice of crop variety, and the management of soil fertility.

Experimental results indicate significant profitability of hand weeding, although herbicides are more labor-saving. Hand weeding must be performed early. The period 15 to 30 days after emergence is the most critical period for weed competition, and weeding must be performed within this period.

State farms use herbicides to manage weeds. Recommended herbicides for weed control in wheat (and barley) are presented in Annex 2, Table 2.

### 2.1.4 Development of Resistance by Pests to Pesticides

Build-up of resistance to pesticides is uncommon in Ethiopia, primarily because of the low average level of pesticide use. Use is particularly low among smallholders. The only record of pesticide resistance comes from cotton pests on state farms. There have also been unconfirmed reports of development of resistance by the maize weevil and grain moth to lindane, malathion, and deltamethrin. The Ministry of Health's Malaria Vector Control Unit reports that resistance to DDT has occurred in a few areas. These areas are treated with malathion, to which mosquitoes are not resistant.

## 2.2 Current Pest-management Practices

Current pest-management practices in Ethiopia can be divided into two broad categories. These are: the small-scale and the large-scale sectors.

### 2.2.1 Small-scale Sector

Pest and disease management in small-scale production relies on traditional methods, mainly cultural methods (such as timely planting date, plant density, crop husbandry, land preparation, intercropping, management of crop residues) and varietal resistance.



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Some cultural practices, particularly intercropping and methods encouraging habitat diversity, create an environment conducive to natural enemies (parasitoids and predators) and can be considered a type of biological control. Thus, the small-scale farmer is a general practitioner of IPM, defined here as the use of two or more pest-management options to keep pest numbers below economically acceptable loss levels. Small-scale farmers' use of pesticides is low (see Table 1.1 above).

Traditional methods for control of weeds affecting a range cereals are also available. Use of chemical methods among smallholders is still low, but somewhat higher than for disease and insect control. Use of herbicides appears most well established in the case of wheat.

### 2.2.2 Large-scale Sector

The main method of pest and disease management in large-scale crop production is the use of pesticides. The major users in the past have been state organizations and parastatals. These include the former Ministry of State Farms Development (MSFD), the Ministry of Coffee and Tea Development (MCTD), the Ethiopian Grain Trade Enterprise (EGTE), and the Ethiopian Seed Enterprise (ESE).

The MSFD is the largest user of pesticides, with an annual application of more than 1.3 million liters (or kg) on various crops (Table 2.7). Of the average amount of pesticides consumed per year in the period 1988 to 1992, cotton accounted for 64 percent of the total, wheat and barley 15 percent, and maize and sorghum 11 percent. Insecticides accounted for 70 percent of total consumption, herbicides 23 percent, fungicides 7 percent, and rodenticides less than 1 percent.

The former MCTD's consumption of pesticides consists mainly of fungicides for use against coffee berry disease and herbicides such as glyphosate for use against couch grass (*Digitaria abyssinicum*) and sedges (*Cyperus* spp.).

EGTE uses pesticides mainly against storage pests. Average annual consumption is above 3,000 kg (or liters) (Table 2.8). Methyl bromide, aluminum phosphide (Phosphine), and Pirimiphos methyl are the major pesticides used. Rodenticides used include zinc phosphide, Klerat, etc.

ESE imports pesticides, mostly insecticide-fungicide mixtures, for seed treatment purposes. Annual consumption is nearly 52,000 kg (Table 2.9). Fernasan D, mixtures of heptachlor and phenylmercury acetate (Agrosan), carbofuran (Furadan), and aldrin are the most commonly used seed treatment chemicals. These represent pesticides used until the 1987-88 season. Data for later years are not available although it is reported that carbosulfan (Marshal) seed treatment is currently being used for maize.



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**Table 2.7: Ministry of State Farm Development - Pesticide Use by Crop** (average 1988-92)

| Crop | Insecticide | Herbicide | Fungicide | Rodent-icide | Total |
|---|---|---|---|---|---|
| Cotton | 842,942 | 5,478 | 7,902 | 272 | **856,594** |
| Wheat and barley | 7,600 | 167,669 | 22,022 | 7,664 | **204,955** |
| Maize and sorghum | 24,364 | 116,963 | 0 | 2,048 | **143,375** |
| Citrus | 28,245 | 6,846 | 12,402 | 0 | **47,493** |
| Vegetables | 16,500 | 0 | 28,445 | 12 | **44,957** |
| Cereals | 15,431 | 1,140 | 23,106 | 60 | **39,737** |
| Rapeseed | 3,800 | 3,648 | 0 | 0 | **7,448** |
| Tobacco | 2,956 | 0 | 0 | 0 | **2,956** |
| Pulses | 0 | 1,860 | 0 | 0 | **1,860** |
| Grape | 0 | 0 | 360 | 0 | **360** |
| TOTAL | 941,838 | 303,604 | 94,237 | 10,056 | 1,349,735 |
| % OF TOTAL | **69.8** | **22.5** | **7.0** | **0.7** | |

Source: Files of MSFD (Research and Advisory Department).

**Table 2.8: Pesticide Amounts (kg or l) Used by EGTE Against Stored-Product Pests**

| Year | Al. phos | M. brom. | P. meth. | Rod. | Other | Total |
|---|---|---|---|---|---|---|
| 1986 | 164 | 58 | 0 | 5 | 9 | 236 |
| 1987 | 1,702 | 2,289 | 0 | 38 | 196 | 4,225 |
| 1988 | 1,859 | 6,620 | 246 | 120 | 95 | 8,940 |
| 1989 | 1,436 | 6,424 | 0 | 245 | 94 | 8,199 |
| 1990 | 937 | 2,121 | 0 | 115 | 248 | 3,421 |
| 1991 | 728 | 0 | 0 | 0 | 0 | 728 |
| 1992 | 822 | 462 | 0 | 80 | 75 | 1,439 |
| 1993 | 819 | 252 | 0 | 93 | 90 | 1,254 |
| 1994 | 826 | 876 | 113 | 0 | 0 | 1,815 |
| 1995 | 390 | 974 | 102 | 49 | 4 | 1,519 |
| Total | 9,683 | 20,076 | 461 | 745 | 811 | 31,776 |

Note: Al. phos, M. brom., P. meth., and Rod. refer to aluminum phosphide, methyl bromide, pirimiphos methyl, and rodenticides, respectively.

Source: EGTE files.



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**Table 2.9: Import and Consumption of Seed Treatment Chemicals by Ethiopian Seed Enterprise** (kg)

| Product name | Up to 1984-85 | 1985-86 | 1986-87 | 1987-88 |
|---|---|---|---|---|
| IMPORTS | | | | |
| Thiram + BHC | 43,175 | 0 | 0 | 0 |
| Thioral + heptachlor | 61,514 | 0 | 0 | 0 |
| Agrosan + heptachlor | 9,002 | 10,500 | 0 | 21,700 |
| Fernasan D Blue | 6,020 | 56,790 | 31,470 | 45,060 |
| Aldrin | 0 | 0 | 0 | 1,885 |
| Furadan | 0 | 0 | 4,200 | 0 |
| TOTAL | 119,711 | 67,290 | 35,670 | 68,645 |
| CONSUMPTION | - | 56,790 | 56,253 | 42,758 |

Source: ESE files.

### 2.2.3 Intensification and Pest Problems

Pesticides are applied moderately to intensively only in the state farms. Small farms use few or pesticides because chemicals are too expensive and supply systems for pesticides do not reach them effectively. Furthermore, pest problems appear to be attenuated, in part, by local farming practices that favor mixed cropping systems.

What will happen to these small farmers' systems of crop management under conditions of intensification? It has been mentioned that maize and wheat diseases (such as leaf blight and head smut for maize and rust for wheat) may increase with intensification. This relation between pests and intensification is thought to hold for insects and weeds as well. Intensification in an Ethiopian context requires a pest-management approach that tries to improve farmers' management practices and increase input use without undermining the basic integrity of their own systems.

## 2.3 New Technology Initiatives and IPM

The MOA's and SG 2000's recommendations for pest management include the use of Marshal as an essential chemical for treatment of seeds, primarily against the maize stalk borer.

The recommended rate of application for Marshal is 360 g/ha. Marshal has never been tested and approved for use in Ethiopia against maize or other crop pests. The manufacturer (FMC chemical company) has provided the only available experimental data on this chemical in Africa--from Cameroon where "Marshal 25 ST" at 3 kg/100 kg of seed was compared with other compounds (carbofuran and ethoprophos) and an untreated check. No data are available on use of Marshal on maize in Ethiopia or elsewhere in Africa.



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The manufacturer claims that "Marshal ST" controls a wide range of soil pests and early foliar insects up to 45 days after planting. Unfortunately, the incidence of the maize stalk borer is such that it can attack the crop long after 45 days after planting, especially if the crop is planted late. The team observed this phenomenon on a field trip to East Wellega zone (see Table 2.3). In addition, the handling of Marshal requires strict safety precautions, including:

- storage in a dry place away from high moisture;
- use of protective clothing, including proper gloves, face mask, long-sleeve shirt, long pants, and rubber boots;
- no eating or smoking while handling; washing after treatment;
- no consumption of treated (leftover) seed; and
- burying of empty packages and materials in a safe location.

Such practices are difficult for small-scale farmers to follow. As noted earlier, research recommendations include timely planting of maize and stalk drying for four to six weeks after harvest as the most important cultural management measures against maize stalk borer. These practices have not been shown to farmers on extension demonstration plots. It is important to include these in future demonstrations as an alternative to the use of insecticides for the treatment of seeds.

Turcicum leaf disease is the most important disease of maize in Wellega and other parts of the country. MSV is also becoming important, especially in warm and humid areas. Cultural practices, including the sowing date, plant population, and the management of soil fertility, and host-plant resistance are the recommended management measures. Research along this line is in progress at the IAR's Bako Research Center.

Rusts (stripe, leaf, and stem rust) are the most important diseases of wheat. Use of resistant varieties, coupled with timely sowing, is the recommended management measure.

Both grass and broadleaf weeds are important on these and other crops. Management measures in small-scale maize production rely on cultural methods (good seed bed preparation, *shilshalo*, and handweeding). The chemical 2,4-D is the most commonly used herbicide for wheat and *teff*.

## 2.4 Summary and Conclusions

### 2.4.1 Promotion of IPM and its Adoption as National Policy

Use of IPM technologies must be promoted at different levels once developed. Resources are needed to implement these technologies. Support will be needed under ERDA at the policy level as well as the extension and farm level. IPM policies require high-level support and coordination



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from both the research and extension side. One effective measure in support of IPM is to initiate training for development agents. Such agents are not at present trained in this subject.

### 2.4.2 On-farm Testing of Available Pest-Management Technologies

Research has produced information on improved pest-management techniques, but most of these have not been tested on a large scale under field conditions. Examples of improved techniques include the early planting as a control on the maize stalk borer, use of botanicals against storage pests, and host-plant resistance and cultural practices against turcicum leaf blight on maize.

Crop protection experts, socioeconomists, and extension agents must take responsibility for implementing such experiments. These can be accommodated in currently planned activities under ERDA at the Bako Research Center.

### 2.4.3 Pest and Disease Surveys and Monitoring

The dynamics of pests and disease, and of their natural enemies, vary with changes in crop-production practices. The current intensification and extensification processes in maize and wheat production are pushing gradually toward a monoculture in the most intensified areas such as Arsi, and it is expected that the rate of change in the pests and disease incidence will increase under such circumstances. Routine pest and disease surveys and monitoring are essential to keep abreast of the status of pests and diseases. The information generated by such efforts will also provide insights into the underlying factors responsible for such changes.

### 2.4.4 Capacity Building for IPM Research and Technology Transfer

The development of human resources and the provision of equipment and facilities will support capacity for IPM management in Ethiopia. Laboratory and greenhouse facilities are necessary for researchers to pursue IPM programs that are already in progress. Extension staff and researchers need transportation facilities to implement their respective responsibilities. Support of this type at the Bako Research Center is anticipated under ERDA. Increased mobility for extension will be supported to allow greater contact and interchange with researchers and to improve the ability of extension agents to demonstrate IPM messages.



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## 3.0 Pesticide Regulation, Policies, and Capabilities

### 3.1 Pesticide Regulatory Agencies

A Special Pesticide Decree (No. 20/1990) issued in September 1990, assigned overall pesticide registration and control responsibilities to the MOA's Pesticides Registration and Control (PRC) Office. Under the MOA's present organizational structure, the PRC Office, together with the Rodent, Weed, and Grain Storage technical offices or teams, constitute MOA's Agricultural Development and Crop Protection Department. The PRC Office is located in the Shola Plant Protection Laboratory, and its staff consists of a Ph.D. level pesticide chemist and three analytical chemists who also function as inspectors on a part-time basis.

Under the special decree: a) all pesticides imported or manufactured in Ethiopia must be registered with the PRC Office; b) registration is granted on the basis of demonstrated product effectiveness and safety for humans, nontarget organisms, and the environment; c) the importation of highly hazardous, severely restricted, or banned pesticides (including most organochlorines) is prohibited; and d) all pesticides must display labels that meet specific MOA label requirements (content, form, color codes, etc.). The decree also seeks to promote safer pesticide handling and use.

In addition, an advisory committee has been established to advise the MOA on issues related to the decree's implementation. The advisory committee consists of seven specialists from the MOA, the IAR, the Ministry of Health, the Ministry of Environmental Protection and Development, the Ethiopian Authority for Standardization, and the Coffee Development Authority.

The PRC Office focuses primarily on issues related to the registration of pesticides, although it is also directly involved in regulation of the sale, application, and storage of pesticides in Addis Ababa. At the regional level, at least 61 regional inspectors, who receive guidance and training from the central PRC team, implement this aspect of pesticide regulation. These regional inspectors have a range of extension and regulatory duties; the enforcement of pesticide regulations is only one such duty.

Extensive media coverage has been given to the decree's issuance and the initiation of the pesticide registration process. This includes reporting on the risks associated with use of the highly toxic insecticide aldicarb (Temik), which is currently circulating on the black market.

### 3.2 Pesticide Registration and Import Requirements

Before issuing the special decree, Ethiopia did not register pesticides. Indeed, the MOA's pesticide registration process is just beginning, and it will probably be some time before it is complete. Applicants are required to submit basic information, as well as data on toxicology, effectiveness, residues, environmental effects, and labelling. Information requirements for registration and required information for labelling can be found in Annex 3. The PRC Office and



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its advisory committee reviews data that have been submitted. The applicant for registration must also submit a sample of the product for analysis. This material is tested in the analytical laboratory at Shola, which three chemists operate. The chemists also function as inspectors when so required.

As a byproduct of the registration process, the PRC Office gathers information on pesticide import patterns and uses and is in the process of creating a registry of pesticides approved for use in Ethiopia. To date, applications and supporting data have been submitted on 102 products, but registration is being processed for only 80 of these. The other 22 applications having been rejected. After the registration process has been completed, no pesticide will be imported or manufactured in Ethiopia unless it has been previously registered with the MOA. The list of registered products, which the PRC Office is compiling, will be for internal use only and is not expected to be published or distributed widely.

An initial registration fee of 1,000 birr (U.S. $159), valid for five years, is charged per product, while registration renewal fees are set at 500 birr (U.S. $79.50). Over 20,000 birr have been generated so far. These revenues do not return to the PRC Office but are remitted to the central government account. Registration requirements are based on standards of the Food and Agricultural Organization and World Health Organization (FAO/WHO), although there is also interest in learning about the requirements of the U.S. Environmental Protection Agency (USEPA).

Pesticide importers are required to demonstrate that they have a valid trading license issued by the Ministry of Trade, appropriate storage facilities, and are knowledgeable of pesticides and their management. Pesticide shipments are inspected for compliance with the special decree's requirements. There are 56 organizations registered for pesticide import in Ethiopia, about 20 of which are active.

Major agrichemical importers include state farms, the Ethiopian Seed Enterprise (ESE), the Malaria Control Program, Ethiopian Amalgamated Ltd., Agricultural Equipment and Technical Services Enterprise (AETSE), and agrichemical companies such as Ciba Geigy, AgrEvo, GCT, and Kemtex.

According to Mengistu Kebede of Ethiopian Amalgamated, state farms import about 70 percent of pesticides, parastatals about 20 percent, and private companies the remainder. The approximate breakdown of pesticide imports by functional groups during 1994-95 is: 52.2 percent insecticides, 43.0 percent herbicides, 4.5 percent fungicides, and 0.25 percent rodenticides (Derso, personal communication, 1995).

All agricultural pesticides used in Ethiopia are presently imported (Derso, personal communication). In the near future, however, the first pesticide formulation plant in Ethiopia, currently under construction near the town of Adami Tulu, about 80 miles south of Addis Ababa, will begin production of dust and liquid formulations of five insecticides.



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### 3.3 The FAO's Prior Informed Consent Procedures

According to Article 9 of the 1990 amended version of FAO's *International Code of Conduct on the Distribution and Use of Pesticides*, a country that cancels or severely restricts the use of a pesticide due to health or environmental concerns must inform the FAO regarding this action. In turn, the FAO notifies the designated authorities in other countries about such action to enable those countries to make informed decisions regarding the future importation and use of the newly cancelled or restricted pesticide.

In the United States, any company wishing to export a product that the USEPA has cancelled or severely restricted must first notify that agency. The USEPA, in turn, informs the importing country regarding the registration status of the products to be exported and the reasons for its cancellation or restrictions. Based on this information, the importing country determines whether it is willing to grant clearance to the potential import. The USEPA then contacts the U.S. exporting firm regarding the importing country's decision.

Ethiopia has participated in this Prior Informed Consent (PIC) arrangement since 1992 and has sent importing country response forms to the FAO concerning the 14 chemicals targeted by PIC thus far: aldrin, HCH (formerly BHC), chlordane, cyhexatin, dieldrin, ethylene dibromide (EDB), fluoroacetamide, heptachlor, hexachlorobenzene, DDT, mercuric compounds, chlordimeform, 2,4,5-T, and dinoseb. Some of these chemicals, such as DDT, aldrin, and dieldrin are still used in Ethiopia.

The PRC Office has also received notification from the European Union regarding pesticides restricted in European Union (EU) member states, in accordance with Regulation No. EU 2455-92.

### 3.4 Regulation of Pesticide Sales, Storage, and Use

The MOA's PRC team primarily deals with pesticide registration issues. With only three part-time inspectors, it has neither the mandate nor the capacity to regulate the sale, use, or storage of pesticides at the national level. Rather, this aspect of pesticide regulation is the responsibility of the regions, each of which is eventually expected to have its own pesticide regulation unit, patterned after the central PRC Office. This is in line with the current government policy of decentralization, which devolves powers to the regions. Functionally, each regional pesticide unit will be under the Shola PRC office.

No special licenses are required to apply pesticides in Ethiopia, and there is nothing equivalent to the USEPA's classification of pesticides as those intended for general use or those designated as Restricted Use Pesticides (RUPs). The classifications are based on human safety and/or environmental concerns. In the United States, only certified applicators or those under their direct supervision can purchase or use RUPs; in contrast, the general public can purchase and apply unclassified ("general use") pesticides. In state farms, employees who have been trained in pest management and use of pesticides supervise the application of pesticides. The



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Government of Ethiopia previously discouraged the use of pesticides among smallholder farmers. There also exists a rather vague edict requiring smallholder farmers to seek support from an extension agent if they are applying pesticides on a large scale.

A special license is required to operate pesticide retail stores. Although the Ministry of Trade issues this license, the MOA's concurrence is required in the form of a supporting letter. The MOA issues this letter based on an assessment of pesticide management and safety procedures that the individuals requesting the permit will use. A university degree or a diploma in agriculture usually suffice to obtain the license. Once the permit is issued to a given individual, however, there is no monitoring mechanism to ensure that the individual will personally supervise the sale of pesticides, rather than an untrained employee. In practice, the person behind the counter is not trained in pesticide management.

Before the MOA issues a supporting letter, a PRC official must inspect the proposed facilities to ensure that these are in compliance with the special decree's requirements. Due to staffing constraints, the inspection of facilities has occurred only in Addis Ababa. To expand the inspection program to the regions, the PRC Office has to date provided short-term (three to five day) training in pesticide management to 61 regional inspectors. This training program will undoubtedly strengthen the inspectors' capabilities to deal more effectively with pesticide issues.

This present review was conducted at a time when the pesticide application season was over, so the team did not have an opportunity to observe major pesticide storage and sale operations. The team observed that specialized pesticide retail stores in Nazareth are all licensed, and that each operate in a single small room, display small stocks of pesticides, and are reasonably clean and tidy. Although some of these stores sell backpack sprayers, none of them offers safety equipment. The saleswoman in one lived in a room adjacent to that housing the pesticide store. Unlicensed general stores and itinerant vendors also carry pesticides.

The Regional Extension Office of East Wellega does not have storage facilities specifically designated for pesticides but temporarily stores pesticides in an all-purpose warehouse. Although this facility is well ventilated and secure, it contains both active and expired products. Products stored here included several 50-gallon drums of 96% malathion for ULV applications, about 200 10 kg sacks of expired pirimiphos-methyl dust, several rusting 25 liter containers of lambda-cyhalothrin (Karate), drums of diazinon (Basudin), and bags of chlorothalonil (Daconil). The team was informed that the PRC Office must determine which pesticides have expired and arrange for their removal and ultimate disposal.

### 3.5 Pesticide Toxicity Classification System and Label Requirements

The PRC Office requires, as one of the conditions for registration, that importers and manufacturers of crop-protection chemicals comply with all aspects of the MOA's labelling requirements. These cover label content, layout, color code, language, size, print size, and quality. Each pesticide package or container, regardless of size, must display the label that the MOA has approved.



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The information content of each pesticide label must include the following: trade, common, and International Union of Pure and Applied Chemistry chemical names; type of formulation; percent active ingredient; pesticide category; net content; inert materials and solvents; safety precautions and protective equipment; storage and disposal indications; hazard signal word; first aid and medical treatment indications; application instructions; distributor's and manufacturer's name; registration number; manufacture date; and shelf life.

The MOA's current requirements for pesticide labels are adequate and comparable to the USEPA's. A three-panel label layout is suggested when the contents exceed 2 kg or l. For smaller (0.5-2 kg/l) containers, a single panel layout is acceptable. The label must be in both Amharic and English. It can include two separate labels, one in each language, when the three-panel layout is used. Alternatively, a container can have a label printed in both languages, side by side, when there is a single-panel layout.

Ethiopia has adopted WHO/FAO's classification according to acute toxicity (Table 3.1). Each product label must be enclosed within a color band denoting toxicity, according to WHO's classification: red + skull and crossed bones danger symbol for WHO classes 1a and 1b (extremely and highly hazardous), yellow for class II (moderately hazardous), blue for class III (slightly hazardous), and green for class IV (hazard unlikely under normal use).

### 3.6 Industry Stewardship

Over the past three years the two major pesticide importers have reportedly implemented a training and registration program designed to strengthen the capacity of their representatives and distributors to manage pesticides. Ethiopian Amalgamated, Ltd. has 680 registered and licensed retailers; AISE has 67 trained wholesalers. Their distributors are expected to attend two- to three-day seminars in the safe handling and storage of pesticides. Training is said to be tailored to local needs and conditions. For this reason a standard training manual has not been developed. Training is provided by Ethiopian Amalgamated staff, some with M.S. degrees and eight years of experience.

AISE's training program is implemented in collaboration with MOA staff. The training and certification program was designed, in part, in anticipation of the requirements associated with the special decree, and in part to ensure that the products will reach end users unmodified and that their use will be consistent with label instructions, as required by the manufacturers. There are no pesticide associations in the country.

The PRC Office has recently provided pesticide training to 61 regional inspectors. The team was unable to ascertain the content and quality of training by the above organizations. Salespersons in pesticide retail stores are also supposed to be trained by their employers, who are invariably the license holders (see section 3.4). The team was unable to ascertain the content and quality of this training program as well.



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**Table 3.1: WHO Classification System According to Acute Toxicity**

| Class | Hazard level | Oral Toxicity ($LD_{50}$ in mg/kg)[a] | | Dermal Toxicity ($LD_{50}$ in mg/kg) | |
|---|---|---|---|---|---|
| | | Solids | Liquids | Solids | Liquids |
| 1a | Extremely hazardous | 5 or less | 20 or less | 10 or less | 40 or less |
| 1b | Highly hazardous | 5-50 | 20-200 | 10-100 | 40-400 |
| II | Moderately hazardous | 50-500 | 200-2000 | 100-1000 | 400-4000 |
| III | Slightly hazardous | over 500 | over 2000 | over 1000 | over 4000 |

[a] Median lethal dose: a concentration of a pesticide that kills 50 percent of test animals, usually rats, expressed in milligrams of pesticide per body weight.

Source: WHO.

## 3.7 Human Resources in Pest and Pesticide Management

The breakdown by discipline of university-trained crop protection specialists in Ethiopia is shown in Table 3.2. Until late 1993, the IAR employed 52 of these specialists, the MOA 51, the former Ministry of Coffee and Tea Development (MCTD) 33, and the rest with various agricultural universities and schools. During the past two years, however, these staffing patterns have undergone significant changes, mainly due to the MOA's restructuring. One of the holders of a M.Sc. degree in pesticide chemistry heads the PRC Office.

## 3.8 Pesticide Formulation, Reformulation, and Repackaging

The Adami Tulu pesticide formulation plant, currently under construction, is funded by the government under the Agricultural Pesticide Formulation Project. The project was preceded by market, technical, financial, and economic analyses, and received technical assistance and



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guidance from the United Nations Industrial Development Organization (UNIDO). The marketing study was based on information the MOA provided.

**Table 3.2: Crop Protection Specialists in Ethiopia**

| Discipline | B.Sc. | M.Sc. | Ph.D. | Total |
|---|---|---|---|---|
| Pathology | 20 | 28 | 5 | 53 |
| Entomology | 12 | 20 | 4 | 36 |
| Crop Protection | 22 | 10 | 0 | 32 |
| Weed Science | 8 | 13 | 2 | 23 |
| Quarantine | 2 | 11 | 0 | 13 |
| Vertebrates | 0 | 6 | 0 | 6 |
| Pesticide Chemistry | 1 | 3 | 0 | 4 |
| Total | 65 | 91 | 11 | 167 |

Source: From "Food Production, Food Security and Nutrition, Pre and Post-harvest Losses," Addis Ababa, 1993.

On the basis of this study, the plant will produce liquid formulations, mainly emulsifiable concentrates (EC), of the insecticides endosulfan, malathion, dimethoate, fenitrothion, and diazinon, as well as an ultralow volume (ULV) formulation of dimethoate. The plant will also produce dust formulations of endosulfan, malathion, and DDT, the latter for malaria vector control. There are no current plans to produce fungicides or herbicides.

Once operational, the plant is expected to reach 85-percent production capacity during its first year, 90 percent during its second, and 100 percent during its third year. The target annual output is approximately 3,000 metric tons of formulated material. Active materials will be imported. In addition, the solvents and other ingredients needed for the liquid formulations will be imported. The inert carriers needed for the dust formulations will be obtained mainly from local deposits of diatomaceous earth.



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The plant will be fully automated. A small team of technicians and engineers who will be trained in pesticide management and provided with safety equipment will operate the plant. An environmental impact assessment preceded construction, and plant design and construction has addressed all potential environmental and health concerns. UNIDO reportedly gave guidance to these design activities.

The team is not aware of any significant reformulation activity in the country. In contrast, pesticide repackaging appears to be common in Ethiopia, reflecting an acute need for the availability in smaller packages. The team observed children selling small packets of what was claimed to be DDT for household use in Nazareth. The material was probably not DDT, as this term is usually applied to any pesticide dust formulation. At the Nazareth market the team also observed the repackaging of zinc phosphide, a highly toxic rodent poison, from its original container into small, unlabeled plastic envelopes, which were being heat-sealed over a hot plate.

No Ethiopian laboratories are now devoted to the analysis of pesticide residues. In 1989, the MOA decided to establish a single laboratory at the Shola Plant Protection Laboratory, with 50-percent dedication to such analysis and 50 percent for use in support of quality control for products sold in the country. After six years, however, the laboratory's construction has not been completed due to lack of funds, and only the portion devoted to quality control is functional. This laboratory supports the ongoing pesticide registration program.

The capability to analyze residues is an essential component of pesticide regulation because it enables a regulatory agency to determine if pesticide residues in agricultural and animal products are within the maximum residue levels (pesticide **tolerances** in the United States) allowed in the country. Ethiopia has adopted the tolerances established by WHO/FAO, although there is presently no way to enforce them.

Analytical capabilities are similarly necessary to ensure that pesticides sold in the country are unadulterated and that the contents of pesticide packages or containers agree faithfully with the content information shown in the product's label. Quality-control programs based on random sampling can be an effective deterrent against adulteration or illegal reformulation of registered pesticides.

### 3.9 Obsolete Pesticides

Considerable amounts of obsolete pesticides appear to be stored in Ethiopia. AISE, for instance, reports that it has 144.2 metric tons and 7,172 l of obsolete pesticides stored in warehouses throughout the country. All expired stocks supposedly will be moved to a single, as yet undetermined, location in Addis Ababa within two months. The warehouse has yet to be rented. Once the transfer is complete, AISE intends to contact the MOA for instructions regarding disposal. It is expected that the MOA, in turn, will contact the FAO for assistance.

In the ERDA project area, the general warehouse of the Regional Extension Office of East Wellega contains about two mt of expired Actellic, as well as small amounts of other expired



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pesticides. The extension office is also waiting for instructions about proper disposal from the PRC Office.



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## 4.0 Pesticide Supply, Demand, and Marketing

### 4.1 Pesticide Supply

Official imports are now the sole source of supply for chemical pesticides. Illegal cross-border imports are not believed to be significant (Derso, personal communication). The newly constructed formulation plant at Adami Tulu, discussed in section 3, will significantly increase insecticide supplies. If its 3,000 metric ton (mt) annual production capacity is realized as suggested in section 3.8, this will be about twice the volume of recent insecticide imports.

From 1987-88 to 1993-94 the average level of pesticide imports for all uses, both agricultural and nonagricultural, was about 4,700 mt (Annex 4, Table 1). As mentioned in section 1, pesticide use in agriculture has been limited. Most use has been by state farms or other state organizations. Cotton grown on state farms has in the past accounted for a major share of pesticide use, particularly insecticides. Low usage in Ethiopia stems in part from the relatively small share of exports in agricultural production, which contrasts with the larger export share of other countries in the region such as Kenya, Tanzania, and Uganda (Szmedra, 1994; Matteson and Meltzer, 1994a and 1994b; Meltzer, Matteson, and Knausenberger, 1994).

In a given year, significant deviations from average import levels occur, as shown in Figures 4.1 to 4.4. Some of these fluctuations are cyclical and result from the need for domestic distributors to purchase every two to three years in order to keep stocks on hand to meet expected demand. Organophosphates, which account for the largest share of pesticide imports, remain effective for several years under normal Ethiopian storage conditions. When stocked in this manner they are readily available to combat new infestations.

Other fluctuations result from exogenous shocks such as the collapse in foreign exchange reserves, which accompanied the fall of the previous monetary regime (the Derg) in 1991. This was undoubtedly compounded by the drop in world coffee prices after the collapse of the International Coffee Agreement in the late 1980s. Figures 4.2 through 4.4 show a sharp drop in all categories of pesticide imports in 1991.

While the value of pesticide imports accounts for only about 2 percent of total import expenditures in most years, official customs data indicate that it can equal or exceed fertilizer expenditures and is thus a substantial component of the total import value of agricultural inputs (Table 4.1, last two columns). Staff of the Customs Department observe that official import data for pesticides include donor-funded imports, so the actual foreign exchange outlay by the government is less than the approximately $25-35 million indicated in Figure 4.1.



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**Table 4.1: Value of Pesticide Imports Compared with Value of Other Imports (000 birr)**

| Year | Value of Fertilizer Imports | Value of Total Imports | Value of Pesticide Imports | Pesticide Imports as % of Fertilizer Imports | Pesticide Imports as % of Total Imports |
|---|---|---|---|---|---|
| 1987 | 72,400 | 2,274,600 | 45,022 | 62 | 2 |
| 1988 | 77,000 | 2,110,400 | 53,220 | 69 | 3 |
| 1989 | 71,800 | 1,824,100 | 60,672 | 85 | 3 |
| 1990 | 29,000 | 2,130,900 | 59,210 | 204 | 3 |
| 1991 | 200 | 1,810,900 | 12,731 | 6,365 | 1 |
| 1992 | 13,200 | 3,618,800 | 101,949 | 778 | 3 |
| Average | 43,917 | 2,294,950 | 55,467 | 126 | 2 |

Source: first three columns, National Bank of Ethiopia Quarterly Bulletin, 9(4) 1993-94, p. 75. Pesticide data from the Customs Department's files.

In 1993, the most recent year for which complete customs data are available, pesticide imports were about 6,000 mt, which is below the average levels of the 1980s. However, imports have recovered from the lows of 1991 and are beginning to approach the volumes of previous years (Figure 4.1). A rapid jump in herbicide imports since 1991 (Figure 4.3) and a slow increase in fungicide imports (Figure 4.4) has spurred the recovery.

The increase in herbicide imports stems in part from continued demand at state farms for treatment of cereals and an apparent moderate increase in smallholder demand for use on wheat and *teff* (conversation with private sector distributors). Insecticide volumes, by contrast, have stagnated due to drastic reductions in cotton area on state farms, which may have fallen by as much as 50 percent since the late 1980s (communication with AgrEvo; Cargill Technical Services, 1994).



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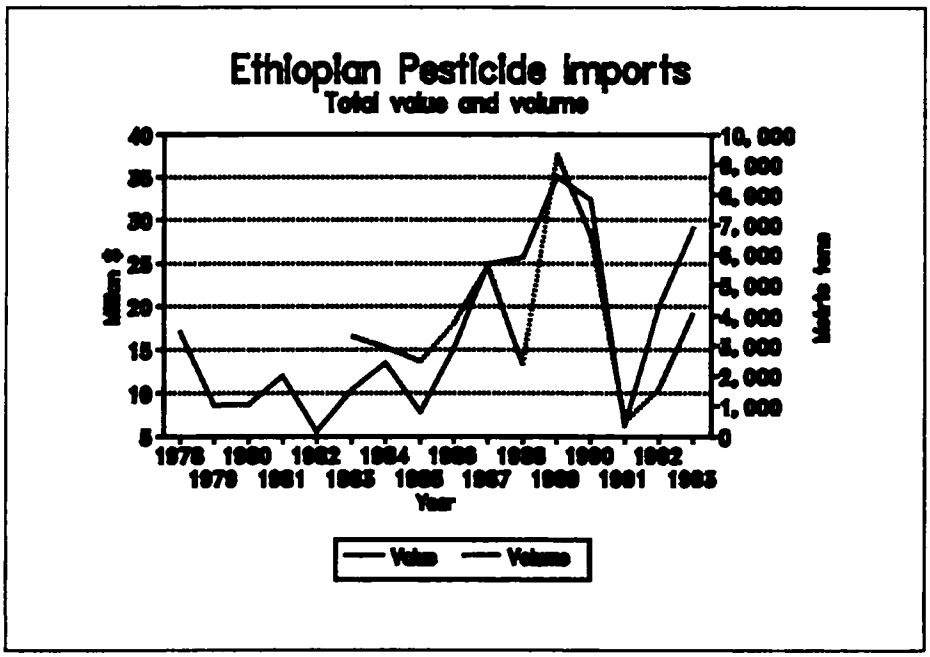
**Figure 4.1: Total Pesticide Imports - Value and Volume**




Note: pesticides are defined to include insecticides, herbicides, fungicides, and rodenticides.

Source: Tables in Annex 4.



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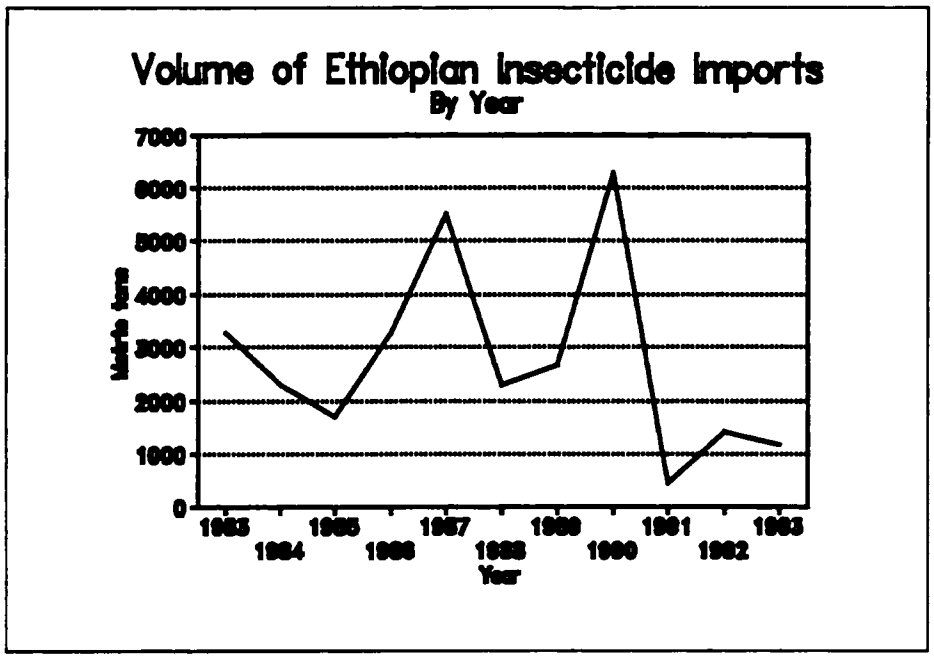
**Figure 4.2: Imports of Insecticides**




Source: Tables in Annex 4.



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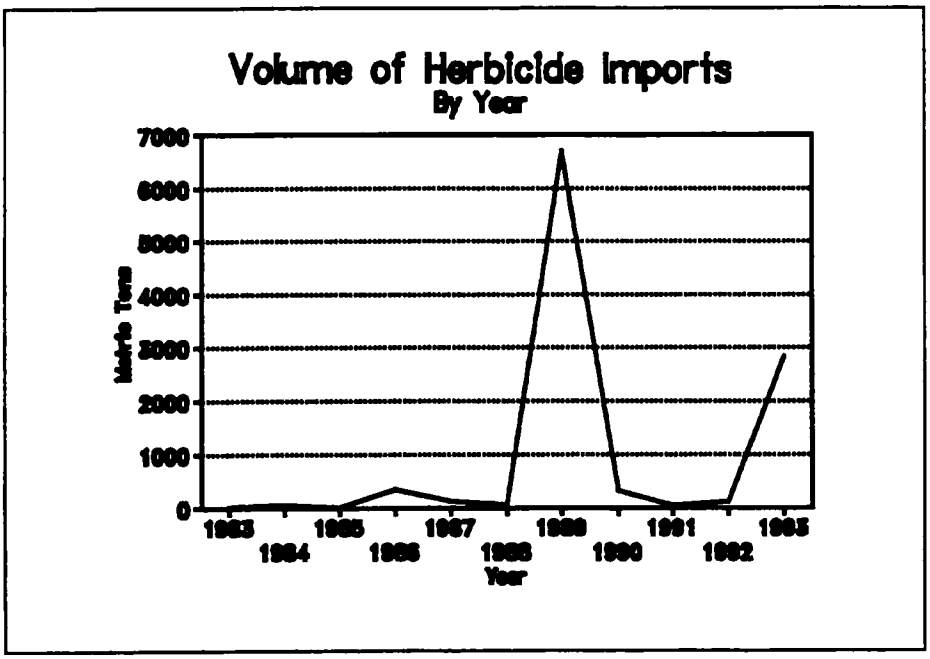
**Figure 4.3: Imports of Herbicide**




Source: Tables in Annex 4.



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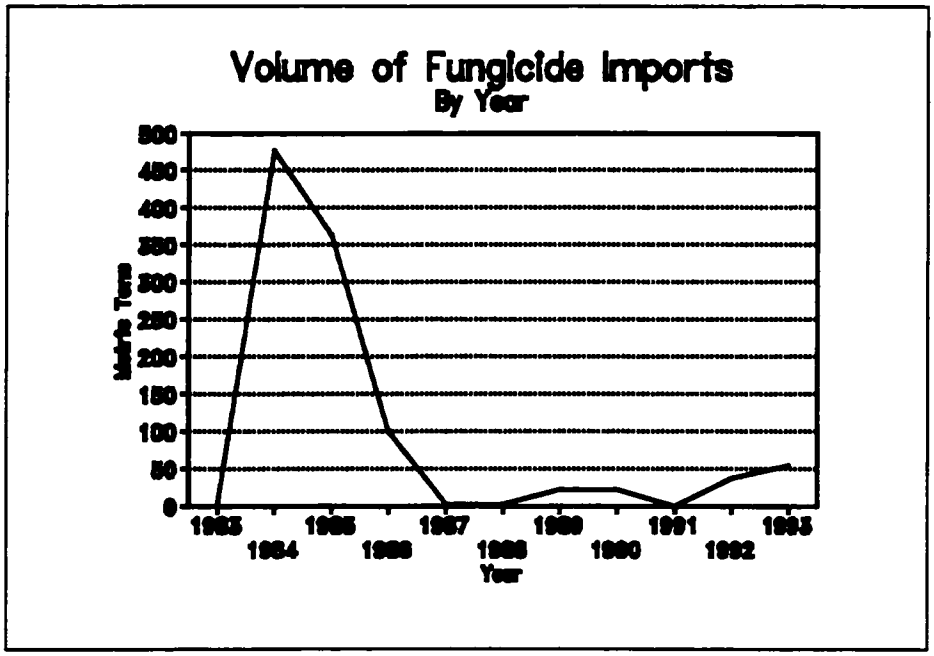
**Figure 4.4: Imports of Fungicides**




Source: Tables in Annex 4.

## 4.2 The Demand for Pesticides

The previous section has noted the decline in pesticide use by state farms as a factor affecting overall import levels. Data the team collected indicate that despite this decline, the share of state farms in total import supplies has remained steady at about 25 percent. Thus, demand from other users has declined as well (Table 4.2, last column). Other users include:

- the Ministry of Health, which imports insecticides for malaria vector control;[10]

- users of chemicals for tsetse control, currently served directly by private importers;[11]

[10] See Annex 5 for a discussion of the central role of pesticides in malaria vector control.

[11] The team was unable to find any government agency that imports or coordinates the import of chemicals to control tsetse flies. The currently promoted chemical is oil-based deltamethrin, which is applied directly to the animal.



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- urban pesticide users--households and businesses that can purchase from the private sector;

- the Ministry of Coffee and Tea Development, which was formerly the central purchaser and distributor of fungicides for coffee;

- the Ethiopian Grain Trading Enterprise (the Ethiopian grain parastatal), which uses small amounts of insecticide for grain storage;

- a limited number of large commercial farmers (e.g., holdings over 50 ha) that use pesticides for such high-value crops as fruits, vegetables, and cotton, or for cereals in some areas;[12] and

- small-scale cereal farmers (After 1992, many were served by AISCO; before this some regional agricultural development projects may have served them in zones such as Arsi).

Geographical patterns of demand are important to consider. Over 45 percent of AISCO pesticide distribution has gone to Addis Ababa and the surrounding Shoa area in recent years (Table 4.3). Interviews with importer/distributors indicate that the private sector has a similar geographic focus.

The reader should note that the sales figures in Table 4.3 do not strictly represent sales to smallholders. AISE currently sells some pesticides to state farms (personal communication with Ato Belisa, AISCO Sales and Distribution Manager). This is particularly true in zones outside Shoa. In East Wellega, for example, AISCO supplies pesticides to state farms but sells only small amounts of Actellic (a storage insecticide) and 2,4-D (wheat herbicide) to smallholders (conversation with AISCO manager, Nekemte, and district extension officials in Sibu Sire *woreda*, East Wellega). Farmers in the area know Actellic because it was distributed free in 1989-90. AISE now sells limited amounts of Actellic to farmers in some districts (conversation at Sibu Sire *woreda* office).

[12] A study by Cargill Technical Services commissioned by USAID in 1994 suggests that cotton production by larger commercial farmers, mostly on former state farm land, is increasing. The study collected information on 36 new farmers with holdings from 80 to 2,000 ha, and on the basis of this estimated that such enterprises accounted for about 10 percent of total cotton production in 1993/94 (Cargill Technical Services, 1994).



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**Table 4.2: Total Pesticide Imports, State Farm Use, and Use by Other Institutions** (000 kg or l)

| Year | Total Import | State Farms Use | Use by Others[a] |
|---|---|---|---|
| 1987-88 | 5,618 | 1,738 | 3,880 |
| 1988-89 | 2,347 | 1,733 | 614 |
| 1989-90 | 9,370 | 1,222 | 8,148 |
| 1990-91 | 6,609 | 1,263 | 5,346 |
| 1991-92 | 473 | 790 | -317 |
| 1992-93 | 1,558 | na | na |
| 1993-94 | 4,062 | 289 | 3,773 |
| Average (not including 1992-93) | 4,746 | 1,172 | 3,574 |

Note: one liter is roughly equivalent to one kilogram.
[a] This column is calculated as the excess of total imports over state farm use.

## 4.3 Policy Reform and Pesticides

The Transitional Government of Ethiopia's New Economic Policy (NEP) was initiated in 1992. Its objective is to "remove cost-price distortions, improve market related incentives, promote private enterprise and exports, progressively liberalize the economy, and consequently, reduce the size and the role of the public sector" (E. Tadesse, 1994). The program mandated several measures likely to have an impact on pesticide supply and demand, for example exchange rate reform, interest rate changes, public enterprise restructuring, market liberalization, and support for private investment.

These policies are reviewed below. The effect of government policies on incentives for farmers and the private sector to adopt pesticides is then discussed. Some government policies, which are not explicit elements of the recent reform program, are also considered, namely import tariffs and land tenure.



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**Table 4.3: AISCO's Pesticide Distribution by Administrative Zone (kg or l)**

| REGION | 1991 | 1992 | 1993 | Average | Regional Average as % of Total Distribution |
|---|---|---|---|---|---|
| S Shoa | 22,000 | 25,600 | 63,661 | 37,087 | 15 |
| E Shoa | 6,400 | 12,150 | 61,310 | 26,620 | 11 |
| W Shoa | 12,500 | 18,100 | 45,550 | 25,383 | 10 |
| Wellega | 22,000 | 32,600 | 16,620 | 23,740 | 9 |
| Addis Ababa | 4,200 | 10,765 | 34,945 | 16,637 | 7 |
| Tigrai | 0 | 52,500 | 3,700 | 18,733 | 7 |
| E Gojam | 2,000 | 32,700 | 13,800 | 16,167 | 6 |
| Illubabor | 13,000 | 25,260 | 8,400 | 15,553 | 6 |
| W Gojam | 0 | 37,680 | 6,850 | 14,843 | 6 |
| Arsi | 0 | 35,600 | 0 | 11,867 | 5 |
| Bale | 30,000 | 2,000 | 0 | 10,667 | 4 |
| N Shoa | 1,700 | 6,600 | 22,885 | 10,395 | 4 |
| Sidamo | 6,000 | 3,550 | 15,250 | 8,267 | 3 |
| N Gondar | 0 | 18,380 | 7,730 | 8,703 | 3 |
| N Omo | 8,000 | 700 | 0 | 2,900 | 1 |
| S Gondar | 0 | 5,000 | 4,200 | 3,067 | 1 |
| E Hararghe | 0 | 0 | 4,100 | 1,367 | 1 |
| TOTAL | 127,800 | 319,185 | 309,001 | 251,995 | 100 |

Note: one liter is roughly equivalent to one kilogram.

Source: AISCO.

### 4.3.1 Macroreforms

Exchange rate policy and devaluation

For most of the 1980s the Ethiopian Birr was fixed at 2.07 birr/$. An auction system was established in October 1992, and the birr became progressively devalued. The current rate is 6.28 birr/$. As shown below, this development has dramatically affected birr-denominated pesticide



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prices. Private importers view the auction as the major factor leading to emergence of an active private import market.

The exchange rate is still overvalued despite the auction's existence (John Cummings, USAID, personal communication). The auction is apparently not clearing the market. Evidence for this view comes from observance of the unofficial rate, which at 7.9 birr/$ is 25 percent higher than the official rate.[13]

Tariff policy

The NEP aims to support exports through reduction in export taxes. Of more direct relevance to pesticide use are the current import tariffs on pesticides (Ministry of Finance, 1995), which include: a) a customs duty, which is 15 percent of the cost of insurance and freight (cif) for insecticides and fungicides and 5 percent on the cif for herbicides; and b) an import sales tax, which is 12 percent of the cif price plus the customs duty for insecticides, fungicides, and herbicides. These taxes substantially increase domestic prices and partially offset the incentive effects of an overvalued exchange rate.

Interest rates

The main thrust of the NEP's financial policy has been to phase out preferential interest rates for state farms and other government organizations. Nominal lending rates are currently 14 percent per annum. Since annualized inflation in 1995 has ranged from 9 percent to 14 percent, lending rates are extremely low in real terms, varying from 4.6 percent to 0 percent. This is undoubtedly lower than the real opportunity cost of capital and reflects some level of credit subsidy.[14]

### 4.3.2 Sectoral Reforms

Input market liberalization

USAID/Ethiopia's Development of Competitive Markets (DCM) Program is an important element of the NEP. In general terms, the program aims to develop competitive fertilizer markets through

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[13] The existence of a large difference between official and unofficial exchange rates provides evidence that the exchange rate is overvalued, i.e., that the number of birr that can officially be exchanged per dollar is too low.

[14] The real opportunity cost of capital for farm households was recently calculated as 46 percent per annum. The calculation method was based on estimation of returns to seasonal grain stockholding and is described in Gordon, Abate, and Bedane (1995). A recent study of rural credit concludes that controls on interest rates result in artificially low lending rates. See ACDI/CEE (1995).



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promotion of increased private sector participation and market liberalization (International Fertilizer Development Center, 1993).

Several contrasts and similarities between the DCM Program and policies for marketing pesticides are worth noting. First, the fertilizer sector has undergone heavier price intervention than the pesticide sector. Official fertilizer pricing involved an explicit subsidy, direct price controls on private transactions, and pan-territorial and pan-seasonal pricing. By contrast, pesticides have not been directly subsidized or price controlled. However, AISE (formerly AISCO) still maintains pesticide prices, which are constant over time and space. This form of subsidy is analyzed below and found to be substantial for East Wellega. In addition, licensing requirements limit private market entry for traders of both inputs and reduce market competitiveness.

Second, the private sector's response to input liberalization has been slow. The response for fertilizer has been greater at the retail and wholesale levels than at the import or distribution levels. For pesticides, in contrast, market entry has been more rapid on the import side with AISE still dominating wholesale and retail networks. The private sector's development is limited, but the public sector's performance also remains weak. It is widely recognized that AISE has difficulty delivering the required quantity of inputs at the right time or place.

Third, cooperatives have in the past played an important role in financing fertilizers and delivering them to farmers, but they have played no role in pesticide marketing. In the past government policy has been to promote pesticides for large state enterprises, not small-scale farmers who are the chief constituents of cooperatives. The current restructuring efforts of cooperatives have thus limited fertilizer demand while not directly affecting pesticide demand.

Fourth, the DCM Program has placed primary emphasis on development of the private sector. Build-up of the public sector's regulatory capacity has assumed secondary importance. Yet external health and environmental costs are far greater for pesticides than for fertilizer (see Matteson and Meltzer, 1994a and 1994b; Meltzer, Matteson, and Knausenberger, 1994).[15] There is thus a stronger argument for market regulation and even taxation. The latter can be justified if private prices do not reflect fully the social costs of fertilizer use and encourage excessive demand.

[15] External costs can be defined as costs that society incurs but which the market does not account for in its transactions. Where such external, or unaccounted for, costs exist, consumers pay a lower cost for the item than is socially desirable. Market prices do not in this case act as indicators of economic efficiency.



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Reforms of state farms and policies affecting new commercial farmers

Under the NEP state farms face higher input costs, increased competition in output markets, and a harder budget constraint.[16] Adjustment has entailed a reduction in the planted areas and input use. Privatization has not proceeded smoothly and has been impeded to a large extent by a poorly articulated privatization strategy for state farms (E. Tadesse, 1994).

In a few locations, such as East Wellega, entry of larger commercial farms onto state farm land or virgin land has been rapid. This is due to heavy tsetse infestations in East Wellega's low-lying areas, which make them unsuited for small-scale ox cultivation, but suitable for tractor plowing.[17] In the past year regional authorities have allowed land leases to fourteen new investment enterprises, many of which have received tractor loans from the Development Bank in Nekemte. A total of 26,750 ha has been transferred to new commercial farmers. This represents a vast area, which compares with 20,000 ha that state farms cultivate in East Wellega, and 73,000 ha by small farmers (see Annex 6, Table 1 for enterprise details). It should be emphasized that much of this newly transferred land is not yet under cultivation. Pesticide dealers in Addis Ababa are not rushing to serve these new enterprises but are waiting to see if the farms will be viable and a steady source of input demand.

Effect of reforms that directly affect input and output marketing

The effect of some of the aforementioned policies is now analyzed. Table 4.4 illustrates how output-input price ratios have changed since 1988-89. These ratios are calculated as the consumer price index (cpi) food price index divided by individual input price indices for the three pesticides 2,4-D, endosulfan, and Actellic, respectively (data on retail prices provided by AISE were converted to indices, with 1988-89 as the base year).

The picture that emerges from these calculations is clear: all ratios decline significantly in 1993-94 and 1994-95 from previous levels, which were near 1.00. The ratio of food prices to the Endosulfan price begins its decline a little earlier. Devaluations beginning in 1992, which increased the birr price of imports, are a key factor explaining these patterns. The reason why ratios do not decline immediately in 1992 is that although AISCO prices rose to reflect the effects of devaluation, food prices offset this with significant increases (Annex 7, Table 1). The full effects of devaluation were not felt until 1993.

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[16] A hard budget constraint is the requirement that state organizations operate within financial boundaries set by budgeted resources. The government does not finance parastatals' losses unless explicit budgetary provisions have been made.

[17] Gavian and Degefa (1994) note similar patterns in other areas of the country and describe a rather ad hoc process of land allocation.



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In recent years farmers have thus faced lower output-input price ratios. This has reduced their incentive to purchase pesticides. The change in incentives in part explains the sluggish demand for pesticides noted previously. Complaints about the high price of pesticides were repeatedly heard during the team's field visits.

Even with reduced incentives farmers may still find it profitable to apply pesticides. This issue is analyzed in a later section, which presents results from a farm budget simulation. The following section analyzes incentives for private marketing agents to deal in pesticides.

**Table 4.4: Ratios of Food Price Index to AISCO Input Price Indices** (1988-89 = 1.00 for output and input price indices)

| Year | Ratio of Food Price Index to 2,4-D Price Index | Ratio of Food Price Index to Endosulfan Price Index | Ratio of Food Price Index to Actellic Price Index |
|---|---|---|---|
| 1988-89 | 1.00 | 1.00 | 1.00 |
| 1989-90 | 1.01 | 0.99 | 1.01 |
| 1990-91 | 0.93 | na | 1.04 |
| 1991-92 | 0.97 | 0.75 | 1.02 |
| 1992-93 | 0.98 | 0.62 | 1.06 |
| 1993-94 | 0.79 | 0.43 | 0.59 |
| 1994-95 | 0.84 | 0.46 | 0.63 |

Note: 2,4-D is a recommended herbicide for wheat and *teff*. Endosulfan is a recommended insecticide for pests affecting maize. Actellic is an insecticide used for maize storage.

### 4.3.3 Policy-related Constraints on Private Trade

This section quantifies policy constraints on private traders, namely implicit price subsidies that can hinder the ability of private traders to compete with AISE. The main issue addressed here is the degree of subsidy implicit in AISE's pan-territorial and pan-seasonal pricing for pesticides. In a later section the report discusses constraints that are internal to the market and will need to be addressed even when policy-related constraints are removed.

The level of subsidy is calculated as follows. Import parity prices for Marshal are calculated at Nekemte through a cost build-up process. First, an import parity price based on financial values



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is calculated to reflect the price a competitive private trader would charge to bring Marshal to Nekemte (Annex 7, Table 2). Second, financial prices are adjusted to remove the effects of import tariff distortions and the 25-percent exchange rate overvaluation (Annex 7, Table 3).

These financial and economic parity prices are then compared to the fixed price at which SG 2000 and the MOA sell Marshal to extension contact farmers in East Wellega (80 birr per 320 gram treatment in the 1995 season). If the parity price at Nekemte is higher than the official sale price, this reveals that pricing policy subsidizes use. If the parity price is lower, an implicit tax is revealed. The results of this exercise show the following:

- an implicit subsidy of 32 percent using financial prices (Annex 7, Table 2)
- a subsidy of 45 percent using economic prices (Annex 2, Table 3)

Since the level of subsidy is higher in the economic price calculation, it is apparent that import tariffs, which raise domestic prices, do not fully offset the effects of exchange rate overvaluation, which lower domestic prices.[18] These subsidy levels are obviously higher in more remote locations, which have higher transport and handling costs added to the cost build-up.[19]

### 4.3.4 Farm-level Incentives for Pesticide Use

When the economic cost of Marshal is introduced into an improved maize crop budget for Gobu Seyo *woreda* in East Wellega, the marginal rate of return achieved in moving from an unimproved budget to a full improved budget is 236 percent. This compares to a rate of return of 268 percent when SG 2000's subsidized price is used in the improved budget.[20] Since any marginal rate of return over 100 percent is considered favorable for adoption, use of the economic import parity price does not change the conclusion of earlier studies, namely that the full extension package is profitable to adopt.[21]

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[18] Note that the economic price calculations take no account of interest rate distortions or external costs such as those discussed in footnote 15.

[19] Costs were collected from a few small firms. These are higher than the costs of a larger firm such as Ethiopian Amalgamated, Ltd., which has close relations with government and a number of advantages. Specifically, the following costs appear to be greater for smaller firms than larger firms: contingency, overheads, interest costs (due to longer period of stockholding), and profits.

[20] The original farm budgets on which this simulation is based can be found in Gordon et al., (1995), Annex 6.

[21] The full package includes 200 kg of fertilizer, hybrid seed, and Marshal. The 100-percent rate of return threshold is recommended in CIMMYT (1988).



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As mentioned in section 2, there is no experimental evidence testing Marshal's effectiveness under Ethiopian conditions. It may be that farmers in East Wellega can attain 40 q/ha with recommended seed and fertilizer application and traditional pest management (i.e., no insecticide application). If this is so, then the improved package without pesticides may look even more attractive than the one with pesticides since a lower cash outlay is required for the former. This hypothesis should be tested. ERDA should support adaptive research that examines the effectiveness of such traditional practices, improved cultural practices, and biological pest controls.

## 4.4 The Marketing and Business Environment

### 4.4.1 The Pesticide Business and Market Development

Private trading networks for pesticide delivery are just beginning to develop after years of state control. The main buyers are still state-connected organizations. Most of the business people based in Addis Ababa that the team interviewed take a long view of the market and foresee slow but steady improvements in market prospects over the next five years.

A number of importers are companies that have branched into pesticides from related businesses such as pharmaceuticals or veterinary drugs. Market entry takes time since many professional staff must have at least B.Sc. level training in entomology and related disciplines. Some local firms such as GCT used to associate with international pesticide firms in order to compete for tenders. With the opening of the process for allocating foreign exchange, GCT now competes on its own (the auction is held every 15 days). The import market as it stands now is highly competitive.

At the other end of the marketing chain are retailers, who are licensed by zonal authorities under a region's authority. Most are general goods merchants who accept pesticides on a seasonal basis. These merchants often store pesticides improperly along with dry goods, farm equipment, food, and other consumer goods. The Regional Agricultural Bureau has in some cases tried to limit direct sales by AISE to small-scale traders and stores due to complaints about adulteration (for instance, traders are often said to mix Coca-Cola with 2,4-D).

In its current state of development the marketing chain is weak on the retail end, but another important problem is the "missing middle." Links between private distributors and retailers are almost absent, and AISE imperfectly fills this gap. This missing middle is slowly being filled by distributors based in Addis Ababa who obtain licenses for pesticide sales in the regions. The process is arduous and took one importer three years to complete in one area. This importer currently has a branch in Mekelle and one in Gamo Gofa and plans to expand to Shashemene and East Wellega. Another importer is branching out by distributing directly to state cotton farms in the Middle Awash area. A third importer is planning to open branches that establish wholesale and retail links in East Wellega.



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In the short term, the private trade sees opportunities arising primarily from AETSE's and AISE's inability to serve the market. They can expect to take a larger share of this existing market, rather than enlarging the market through aggressive promotion efforts. Growth in demand is slow due to policy reforms and institutional turmoil.

Most firms are taking the long view and waiting for the market to stabilize. Among the most important factors that could stabilize the business environment are the following:

- clearer definition of AISE's market role and the elimination of hidden subsidies;

- resolution of problems with land tenure, which will allow larger private investors to buy and hold land;

- improvements in the efficiency of the licensing process at regional level; and

- reduction in donor supplies of free or subsidized pesticides to control migratory pests. Smallholder farmers are said to use these donated pesticides improperly to control nonmigratory pests. Subsidized distribution of pesticides from donors can also distort market prices.

### 4.4.2 Proposed Input Market Development Project by SG 2000

The rapid expansion of SG 2000's demonstration plots has undoubtedly increased the demand for pesticides among small-scale farmers, but they are rarely able to find them on the private market. SG 2000 has proposed a project to assist development of a network of small input dealers. The proposal outlines plans to construct small retail input shops, to train local merchants, and to sell the shops on low-interest credit terms to merchants. In East Wellega, SG 2000 plans four shops in Sibu Sire *woreda*, with four in neighboring Bako *woreda* (West Shoa zone).

Project activities in the first two-year phase include (SG 2000, 1995): a) screening and training of prospective purchasers; b) construction of stores from obsolete freight containers; c) transport subsidies to assist distribution; and d) start-up loans for stockists.

The proposed project's aim is to promote development of a self-sustaining system for input supplies. The project proposal as currently written raises two concerns. First, the level of subsidized resources leads to doubts about its sustainability. Second, the proposal identifies lack of storage facilities as a major marketing constraint, an assumption that the recent Agridec (1995) report correctly questioned.



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## 4.5 Rural Credit and Microenterprises Marketing Pest Management Technologies

Rural microenterprises involved in the marketing of pesticides and IPM technologies require cash both for working capital and investment needs. According to a recent USAID-supported rural credit study, small businesses lack ready access to credit to satisfy their immediate and longer term cash requirements: "Microenterprise and small business credit is all but unavailable from the formal banking sector, and informally only at uneconomical rates..."[22] Researchers who have studied Ethiopian rural finance are somewhat less pessimistic about traders' informal sector credit opportunities.[23]

The team observed current and emerging pesticide marketing agents in rural towns in Arsi, Arsi Negele, Shashemene, Awassa, West Shoa zone, and Nekemte (East Wellega zone). Agents currently engaged in pesticide marketing tend to be small enterprises such as general consumer goods shops, building supply stores, or veterinary drug stores. In Shashemene, pesticides are sold in an open market. No clear picture of credit access emerged in the team's interviews, but small shop owners generally appear to be sources of cash rather than borrowers. Many can undoubtedly finance short-term cash requirements out of their own reserves. Thus, an additional difficulty arises in regard to the SG 2000 input market development project proposal: it may not be necessary to provide start-up loans for stock purchase to small businesses.

The ACDI/CEE study makes a number of recommendations regarding financial policies and the private sector's development. If followed these recommendations will assist in deepening the financial sector and improving access to credit in rural areas. These include removal of interest rate and other subsidies, development of a wider range of loan instruments by banks, more efficient loan administration, and improved financial skills and record keeping for private entrepreneurs. One recommendation is particularly relevant to the SG 2000 proposal: "Support the development of 'mom and pop' rural input supply businesses and private grain traders to represent their interests and serve as financial intermediaries for channeling commercial credit from public and private financial institutions."[24]

This suggests another dimension to the proposed SG 2000 project, which is consistent with the view suggested above of small stores as (potential) lenders rather than borrowers. The proposed project should look carefully at the current and potential financial function of small input-supply businesses to determine the extent to which they can indeed serve as financial intermediaries and lenders to farmers or to other small businesses. If so, it may be possible as part of the SG 2000 project to develop specific project activities aimed at improvement of rural finance, which will benefit the marketing system as a whole.

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[22] See ACDI/CEE (1995), p. 5.

[23] See Aredo (1993a and 1993b) for a discussion of the iqqub, an informal rotating savings and credit association.

[24] ACDI/CEE (1995), p. 9.



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A final point should be made regarding the supply of IPM technologies in rural areas. The team visited the Bako Rural Technology Center and discussed technologies generated by the center for pest management and control of storage pests. These include planters, shellers, and improved cement-foundation storage structures. The center's staff indicated that local manufacturing and marketing capacity for the mechanical implements is weak and remains to be developed. The storage structures incorporate materials (e.g., corrugated iron roofing)that may not be available in remote areas or that may be beyond the financial reach of small farmers. There is thus a need to improve local marketing capacity for such items. Careful analysis of the economic viability of these implements and structures under farm conditions must precede such an effort.

### 4.6 Conclusions Regarding Pesticide Supply and Demand

The section's main conclusion is that the development of a market for private inputs requires both direct support from ERDA as well as indirect support through policy conditionalities that reduce constraints on the private sector. These are summarized below.

Business Training and Organization

- Input dealers, some of whom will undoubtedly branch into pesticide input delivery, should be trained in general business practices. Such general training will occur in ERDA project zones. Training in the business and technical aspects of pesticides is also necessary. Topics could include demand forecasting, stock management, and the technical aspects of handling and use. This training is also anticipated in East Wellega and the expansion zones.

- Support may be needed to help establish associations of input dealers. This could involve technical assistance to help establish bylaws or to assist in compliance with regulations. This activity should be part of the planned ERDA project's zone workshops.

- Workshops should be used to identify and train local distribution networks and link them with suppliers in Addis Ababa. Such workshops are already planned in ERDA project zones. As mentioned above, direct assistance could also be given to the regions to help improve licensing and regulation.

- Workshops should be used to identify constraints on private trade that arise from existing regulations or their inefficient enforcement. Measures to eliminate constraints should start with discussions with regional and zonal officials, who should attend workshops, and if necessary, extend to policy conditionality.

- The proposed SG 2000 Input Market Development Project should, in any anticipated pest-management related activities, focus efforts on improving traders' knowledge of proper pesticide handling, storage, and application. The project should also place emphasis on activities that increase the supply and marketing of IPM technologies, in cooperation with the Bako Rural Technology Center. Finally, the project should explore the possible role of input businesses as



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financial intermediaries, and develop interventions which can, to the extent possible, assist these businesses.

Policy Conditionality

- ERDA's policy conditionality should emphasize elimination of subsidies to AISE. As a competitive enterprise, AISE should no longer have free use of the MOA's facilities or services, preferential access to cheap credit, or any other advantages that limit the ability of private firms to compete with it. AISE should be charged for fixed assets (including vehicles) inherited from the government. In addition, AISE should phase out the subsidies implicit in its practice of pan-territorial and pan-seasonal pricing.

- As a market development measure, ERDA conditionality should reduce and eventually eliminate distribution of subsidized chemicals for migratory pest control. Pesticides intended for migratory pests are at times used on nonmigratory pests. This practice increases demand for pesticides among farmers who may not need them.



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## 5.0 Assessment of Pesticide Use in Relation to USAID's Pesticide Procedures

### 5.1 Pesticides in the Context of the Ethiopian Resources for Developing Agriculture (ERDA)

#### 5.1.1 Pesticides Used in Ethiopia or Recommended by the MOA for Maize and Wheat

The ERDA project seeks to strengthen the capability of smallholder farmers to increase maize and wheat production in several cereal-producing locations. The government's extension technology package program is using demonstration plots to increase farmers' knowledge of technical packages, which include fertilizer, improved seed, and pesticides. The MOA and SG 2000 implement these programs. ERDA will support ongoing programs through support for specific package elements that are seen as effective and sustainable.

The pesticides that the MOA's Extension Program recommends for use on wheat include the herbicides Granstar, Brittox, Agroxone, Starene 728 EC, and 2,4-D for management of broadleaf weeds, and Moran, Grasp, and Puma Super for management of grassy weeds. The MOA does not recommend insecticides for use on wheat. The only herbicides the MOA recommends for use on maize and sorghum are Primagram and Gesaprim. The MOA also recommends the use of the insecticides Karate 5% EC, endosulfan 35%, and Actellic for use on maize (Table 5.1).[25] At present, SG 2000 is also promoting the use of Marshal for maize seed dressing as a protection against the stalk borer in its demonstration plots. It can be assumed that the MOA implicitly approves the use of Marshal for seed dressing because the MOA's extensionists manage the SG 2000's maize demonstration plots.

In addition, for emergency control of armyworms, USAID has approved, based on a supplemental environmental assessment (SEA) of African armyworm control in Ethiopia (USAID, 1994), the use of carbaryl 85% wettable powder (WC), chlorpyrifos 24% ULV EC, malathion 50% EC, and fenitrothion 95% ULV. Similarly, based on an SEA related to the control of migratory locusts and grasshoppers (USAID, 1993), USAID has approved the use of acephate, bendiocarb, carbaryl, chlorpyrifos, diazinon, fenitrothion, lambda-cyhalothrin, malathion, and tralomethrin. Both of the SEAs indicate mitigative actions and practices that should be followed for safe and effective control operations. Before USAID's assistance for a prospective control campaign is approved, the Government of Ethiopia or the NGO requesting assistance must prepare a specific action plan that addresses the concerns raised in the two SEAs.

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[25] The MOA's recommendations do not imply active promotion of pesticides among small-scale farmers. In fact, the MOA has not actively approached such farmers in the past, and this situation is not anticipated to change in the near future.



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**Table 5.1: Pesticides Recommended by MOA for use on ERDA's Target Crops**

| Trade Name | Common (Technical) Name | Maize | Wheat |
|---|---|---|---|
| INSECTICIDES | | | |
| Marshal[a] | Carbosulfan | x | |
| Endosulfan | Endosulfan | x | |
| Karate | Lambda-cyhalothrin | x | |
| Actellic | Pirimiphos methyl | x | x |
| HERBICIDES | | | |
| Granstar | Metsulfuron methyl | | x |
| Brittox | Bromoxynil+ioxynil+mecoprop | | x |
| Agroxone | MCPA | | x |
| Starene | Fluroxpyr-meptyl | | x |
| Moran | (not available) | | x |
| Grasp | Tralkoxydim | | x |
| Puma | Fenoxaprop ethyl | | x |
| Illoxan | Diclofop methyl | | x |
| Primagram | Atrazine+metolachlor | x | |
| Gesaprim | Atrazine | x | |
| (many) | 2,4-D | | x |

[a] Recommended by SG 2000. Source: MOA.



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### 5.1.2 Basis for the MOA's Selection of Pesticides

The MOA bases recommendations for pesticide use on those of the IAR. The IAR conducts tests of pesticides' effectiveness from time to time.

The use of the Marshal, proposed by SG 2000, is an exception, since apparently IAR has not conducted any field trials that would specifically test its effectiveness as seed dressing against the maize stalk borer. According to Ethiopian Amalgamated, Ltd. and other sources, SG 2000 has imported 10,000 kg of Marshal based on its experience in Tanzania, Kenya, and Zambia.

### 5.1.3 USEPA Registration Status of MOA-recommended Pesticides for Maize and Wheat

The MOA recommends at least 14 pesticides (3 insecticides and 11 herbicides) for use on maize and wheat. In addition, SG 2000 promotes Marshal for seed treatment. Of these, five are Class I (highly toxic), five are RUPs, four are not registered or marketed in the United States, two are still unidentified by the team, and six are for "general use." Marshal is both in the Class I (highly toxic category for some formulations) and not registered for use in the United States (Table 5.2).

The Federal Insecticide, Fungicide, and Rodenticide Act requires the USEPA to register all pesticides used in the United States. Based on risk-assessment criteria, the USEPA classifies pesticides in two broad categories, RUPs and unclassified pesticides ("general use"). In addition, pesticides are assigned to one of four classes on the basis of toxicity to humans: I, II, III, and IV; class I contains the most toxic and class IV the least toxic pesticides (Table 5.3).

In the United States, RUPs may be purchased and applied only by or under the supervision of a certified pesticide applicator. Most RUPs are also class I pesticides and are thus highly toxic to humans. Other pesticides are classified as RUPs because of the potential risk that their use poses to aquatic organisms, wildlife, and other nontarget organisms. Unclassified pesticides are relatively safer, provided that label instructions are followed closely. Members of the general public can purchase and apply unclassified pesticides without the need for a special license.

The USEPA is presently in the process of reregistering pesticides registered prior to 1984. Consequently, due to environmental and health concerns, the use of an undetermined number of products may be restricted or cancelled during the next few years.



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**Table 5.2: Toxicity and Registration Status of Pesticides Recommended by MOA for use on ERDA's Target Crops**

| Common/Trade Name | Acute Toxicity ($LD_{50}$ in mg/kg) | | USEPA Toxicity Class & Signal Word | USEPA Registration Status/Remarks |
|---|---|---|---|---|
| | Oral | Dermal | | |
| INSECTICIDES | | | | |
| Carbosulfan (Marshal) | 209 | >2,000 | I,II - Danger, Warning | Not regist. in the U.S. |
| Endosulfan | 22.7-160 | 359->500 | I, Danger | Restricted Use |
| Lambda-cyhalothrin (Karate) | 56-79 | 632-696 | I, Danger | Restricted Use |
| Pirimiphos methyl (Actellic) | >2,000 | >4,592 | III, Caution | Unclassified (General Use) |
| HERBICIDES | | | | |
| Metsulfuron methyl (Granstar) | >5,000 | >2,000 | IV, Caution | General Use |
| Bromoxynil[a] | 365 | >2,000 | II, Warning | General Use |
| Ioxynil[a] | 110-390 | ----- | | U.S.: not marketed |
| Mecoprop[a] | 1,166 | >4,000 | II, Warning | General use |
| MCPA (Agroxone) | 1,160 | >4,000 | I, Danger (some formulations) | Restricted Use (some formulations) |
| Fluroxpyr-meptyl (Starene) | >5,000 | >2,000 | IV, Caution | Not registered in the U.S. |
| (Moran) | | | | |
| Tralkoxydim (Grasp) | 934-1,324 | | III, Caution | U.S.: not marketed |
| Fenoxaprop ethyl (Puma) | 2,565 | >2,000 | III, Caution | General Use |
| Diclofop methyl (Illoxan) | 512 | >5,000 | III, Caution | Restricted Use |
| Metolachlor (Primagram)[b] | 2,780 | >10,000 | III, Caution | General Use |
| Atrazine (Gesaprim) | 1,780 | >3,100 | III, Caution | Restricted Use |
| 2,4-D | 699 | | I, Danger (Dimethylamine salt) | General Use |

[a] Components of the herbicide Brittox,
[b] Primagram is a combination of atrazine and metolachlor

Source: USEPA.



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**Table 5.3: USEPA Criteria Used to Establish Toxicity Categories for Pesticides**

| Hazard indicators | Category I: | Category II: | Category III: | Category IV: |
|---|---|---|---|---|
| Oral $LD_{50}$ | ≤50 | 50-500 | 500-5,000 | >5,000 |
| Inhalation $LD_{50}$ (mg/liter) | ≤0.2 | 0.2-2 | 2-20 | >20 |
| Dermal $LD_{50}$ | ≤200 | 200-2,000 | 2,000-20,000 | >20,000 |
| Eye effects | Corrosive, corneal opacity not reversible within 7 days | Corneal opacity reversible within 7 days; irritation persisting for 7 days | No corneal opacity; irritation reversible within 7 days | No irritation |
| Skin effects | Corrosive | Severe irritation at 72 hours | Moderate irritation at 72 hours | Mild or slight irritation at 72 hours |
| EPA signal word | "DANGER" | "WARNING" | "CAUTION" | "CAUTION" |

Source: USEPA.

### 5.1.4 Effectiveness of the MOA-recommended Pesticides Being Considered for Expected Uses

As noted above, there are limited data on the efficacy of pesticides on crops in Ethiopia. The data that do exist are generated primarily by the IAR or CIMMYT and are largely used by large farms. Despite the paucity of relevant data, fungicides, herbicides, and insecticides have been evaluated in Ethiopia, but these evaluations have not yet affected the MOA's recommendations. Section 2 and Annexes 2 and 8 provide some of this information on effectiveness, as do Assefa (1995), CIMMYT (1988), Chiche (1995), Gebre-Mariam (1991), Stroud (1989), Tanner (1994), and Tolessa and Ransom (1992). The present report does not specifically review these data to reflect on the pesticides' efficacy. The team's judgment is that smallholder farmers in East Wellega are unlikely to use pesticides in the immediate future. Indeed, the team is not recommending the use of pesticides on maize or wheat (see section 5.4.2).

### 5.1.5 Availability and Effectiveness of Other Pesticides or Nonchemical Control Methods

Many pesticides have been evaluated throughout the world for effectiveness against the spectrum of pests on maize and wheat. Some of these pesticides could be used effectively in Ethiopia, but local validation trials should precede such use. Some such trials are now underway. Further development of alternatives, especially nonchemical ones such as the bacterial bioinsecticide, *Bacillus thuringiensis*, might be encouraged through ERDA's activities. Annex 9 identifies longer term priorities for an IPM program in Ethiopia.

Smallholder farmers in Ethiopia regularly implement crop-management practices that can be categorized as cultural IPM techniques. These include complex mixed cropping systems, intercropping, crop rotation, and sanitation. Given the agroecological complexity of this form



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of agriculture and the limited use of chemical pesticides, most potential insect pests here are probably under some form of biological control. Continuing to keep pesticide use to a minimum by applying them selectively and only when absolutely necessary will help to conserve these natural enemies and foster their effectiveness.

Other potential nonchemical management methods that can be explored under ERDA include:

Promoting early planting of maize to avoid infestations of stalk borers.

Planting only varieties that have been shown to be tolerant or resistant to local plant diseases.

Promoting the adoption of appropriate grain storage methods to minimize damage from insect and rodent pests.

Testing the potential antifeedent, repellent, or insecticidal effects of botanical products such as neem seeds and leaves (*A. indica*), pepper tree (*Schinus molle*), and Persian lilac.

Testing the potential effects of diatomaceous earth as a protector of stored seeds against insect pests. Deposits of diatomaceous earth exist in the country and can be mined and processed for this purpose. Diatomaceous earth acts by physically scarring the protective wax layer on the insect cuticle, causing death by dehydration. On the negative side, diatomaceous earth can cause eye irritation under prolonged exposure, and its use under enclosed conditions requires goggles. Diatomaceous earth is marketed for household use in the United States against ants and other crawling insects.

Supporting the design and testing of effective low-technology weeding implements.

Rotating cereals with noncereal crops decreases the prevalence of weeds and soil-borne plant pathogens. Rotation with legumes will, in addition, help to replenish depleted soil nitrogen.

### 5.1.6 Extent to Which Ethiopian Pesticide Use Can Be Part of an IPM Program

Pesticides are applied moderately to intensively only at Ethiopia's state farms. In contrast, small-scale farmers use few pesticides because chemical control is generally too expensive. Furthermore, local farming practices, which favor mixed cropping systems, appear to attenuate some pest problems. Characteristically, even small parcels in the East Wellega support a variety of food crops.



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Unlike monocultures, which tend to favor the proliferation of pest organisms, the kind of complex polyculture practiced in Ethiopia is unlikely to lead to the population build-up of any one pest species (Altieri, 1995). In addition, the food supply is insufficient to support high populations of specialized herbivorous insects, which otherwise reach severe pest status when there is an abundance of their preferred food plant. In addition, mixed cropping systems tend to encourage a higher abundance of pests' natural enemies, which in turn become more effective in controlling the pests under such conditions. Also, because most of East Wellega's agricultural areas have not been subjected to intensive pesticide use, a practice that is highly detrimental to beneficial insects, the local natural enemy fauna is probably diverse and abundant. Local agriculture is, thus, highly favorable to the expression of natural management of insect pests through the action of their native predators, parasitoids, and diseases. Unusual opportunities are thus available for fostering the use of cultural practices, biocontrol, and other nonchemical pest-management methods.

### 5.1.7 Methods of Pesticide Application and Availability of Application and Safety Equipment

Ethiopia's small-scale farmers typically apply liquid pesticides with backpack sprayers. Granular and dust formulations are usually applied directly from containers or by hand. Small-scale farmers do not normally use special protective equipment, such as respirators, safety goggles, or rubber footwear when handling or applying pesticides. Such lack of protection is found generally and was observed by the team in several locations. Protective items are not available for sale in retail stores or anywhere else in the project area. Pesticide safety equipment would be prohibitively expensive, even if it were available, for most small farmers.

Training and technical assistance in the safe handling and appropriate application of pesticides needs to accompany any recommendation of pesticide use under the ERDA Project. In addition, only pesticides that need a minimum amount of protection (long-sleeve shirts, trousers, and footwear) should be recommended under ERDA. Pesticides requiring the use of special safety gear, such as respirators, safety goggles or face shields, or rubber aprons, gloves, and boots, should not be recommended.

### 5.1.8 Acute and Long-term Toxicological Hazards Associated with Ethiopian Pesticide Use and Measures Available to Minimize Them

The main health and environmental concerns for the pesticides listed in Tables 5.1 and 5.2 are summarized below.

> **Lambda-cyhalothrin (Karate)**: Pyrethroid. Restricted use pesticide. Eye irritant. Protective equipment required: protective goggles and gloves. Highly toxic to fish and aquatic invertebrates (all formulations). Apply $CO_2$, foam, dry chemicals in case of fire.



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**Endosulfan (35%)**: Sulfurous acid ester of chlorinated cyclic diol. Restricted use pesticide. Highly toxic to humans, fish, and birds. Moderately toxic to bees. Central nervous stimulant. No specific antidote available. Application requires fully protective gear, including respirator.

**Carbosulfan (Marshal)**: Carbamate. Not registered in the United States. Handling and application requires fully protective clothing and respirator. Antidote is atropine. Apply foam, $CO_2$, or dry chemical in case of fire.

**Pirimiphos methyl (Actellic)**: Organophosphate. Antidote is atropine. Highly toxic to fish and birds. Requires protective goggles or face shield when handling. Water fog, foam, $CO_2$, dry chemical recommended in case of fire.

**Components of Brittox: Bromoxynil**: Use rubber gloves and protective clothing when handling concentrate. For small fires apply $CO_2$ or dry chemical, water for major fires. **Ioxynil:** Wear protective clothing.

**MCPA (Agroxone)**: Some formulations are restricted use pesticides. Can cause irreversible eye damage. Must wear goggles or face shield when handling. Avoid contaminating water. Unknown antidote. Do not induce vomiting if ingested. Moderately toxic to birds.

**Fluroxypyr meptyl (Starene)**: Highly toxic to fish.

**Tralkoxydim (Grasp)**: Must wear goggles and protective clothing when handling concentrate.

**Fenoxaprop ethyl (Puma)**: Requires wearing goggles, face shield, rubber gloves, and protective clothing while mixing. Avoid eye contact. If ingested, do not induce vomiting.

**Atrazine (Gesaprim)**: Restricted use pesticide (based on ground water contamination and worker exposure). Must leave buffer areas between application sites and surface water. Gloves required when handling. In case of fire, apply $CO_2$, dry chemical or water.

**Primagram (atrazine + metolachlor)**: Restricted use pesticide. Highly toxic to birds and bees. Handling and application requires goggles, rubber gloves, boots, and protective clothing. Apply $CO_2$, foam, or dry chemical in case of fire. If ingested, induce vomiting by drinking water.

**2,4-D**: Dimethylamine salt is an eye irritant. Handling and application requires rubber gloves, eyewear, long-sleeved shirt, long pants, rubber boots, and rubber apron.



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**Diclofop methyl (Illoxan)**: Most formulations are restricted use pesticides due to concerns about oncogenicity (tumor formation). Its handling and application require goggles, cartridge-type respirator, rubber gloves, hat, boots, long pants, and long-sleeved shirt. Toxic to fish. Do not induce vomiting if swallowed.

If carbamate or organophosphate pesticides (OP) are to be used for adaptive and validation research under ERDA, a readily available supply of the treatment, atropine sulphate, should be kept at convenient field locations. Two such products are listed in Tables 5.1 and 5.2: pirimiphos methyl and Marshal, a carbamate.[26] It should also be kept in mind that most pesticides used in Ethiopia are insecticides, of which at least 75 percent are OPs and carbamates. Symptoms of OP acute and carbamate pesticide poisoning are identical to the symptoms of nerve gas poisoning (dizziness, disorientation, constricted pupils, salivation, nausea, vomiting, etc.). Atropine is the antidote used in treatment of poisoning due to exposure to OP and carbamates. No specific antidotes exist for the treatment of poisoning with endosulfan.

ERDA will need to ensure that local medical personnel are knowledgeable about the treatment of OP-carbamate poisoning and that a supply of atropine sulphate is always at hand in the event that ERDA supports the use of OPs and carbamates in the project area. It is essential to highlight the fact that atropine treatment is specific for the treatment of OP-carbamate poisoning and that it should never be used for treating intoxications due to other pesticide groups. After rendering first aid, medical help should be sought immediately in all cases of acute intoxication. Since pesticide labels include indications for medical treatment in case of poisoning, the original label of the chemical should be provided to the physician.

Since the first aid procedure of accidental exposure to pesticides is to get rid of contaminated clothing and clean the affected areas with soap and abundant running water, it will be essential that any location where pesticides are to be mixed, loaded, handled, or applied be provided with shower facilities and soap. It is also recommended that pesticide applicators use separate clothing when applying pesticides and that, after handling or applying pesticides, such clothing be removed and washed separately with soap after each spray operation to avoid mixing them with the regular laundry at home.

Any pesticide spills should be immediately dammed-off and pumped into suitable containers for reuse or disposal. The remainder should be collected with absorbent material (sand, soil, sawdust) and disposed of in accordance with local regulations. Solid spillages should be vacuumed with an industrial vacuum cleaner for reuse or disposal.

Given the present conditions in rural Ethiopia, it is unrealistic to expect that most of these precautions will be observed throughout the project's area of influence. Therefore, human safety and environmental concerns must weigh heavily in any future decisions to recommend pesticide use under ERDA, and only the safer products should be recommended. In addition, since

[26] This report neither endorses nor recommends Marshal.



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accidental exposure and spills with even the less toxic of the organosynthetic pesticides can have adverse consequences for humans and their immediate environment, any recommendation of pesticide use for small-scale farmers should include technical assistance and guidance in safe pesticide handling and use.

### 5.1.9 Compatibility of MOA-recommended Pesticides with Target and Nontarget Ecosystems

All project implementation sites will be restricted to agricultural areas devoted predominantly to the production of cereal crops. There are no protected areas, such as national parks and wildlife preserves, nor natural forests or other undisturbed biotic communities in the vicinity of these areas. Moreover, ERDA will promote adoption of nonchemical approaches to pest management, and the use of pesticides in project implementation areas is expected to remain at low levels.

Even when the use of pesticides is low to moderate, there are always potential risks associated with such use. For instance, accidental spills, usually associated with pesticide mixing and loading areas, can have localized but severe environmental impacts if not dealt with rapidly and adequately. Pesticide drift, which is intensified by spraying on windy days, can be harmful to nontarget crops, natural vegetation, and nontarget organisms in surrounding areas. Spraying against the wind can result in the applicator's intoxication.

Beneficial arthropods, such as pollinators and insect pests' natural enemies (parasites and predators) are particularly vulnerable to wide-spectrum insecticides. The intensive application of insecticides will eventually reduce or eliminate populations of natural enemies, thus promoting the unchecked increase of pest populations and the outbreaks of secondary pests. The development of resistance to pesticides in pests is another serious consequence of pesticide overuse. Water runoff associated with heavy rainfall can transport pesticides and their metabolites to distant places located downstream, resulting in the contamination of surface and ground water in those areas.

To minimize the risks associated with any kind of pesticide use, ERDA will need to promote the adoption of suitable pest and pesticide-management practices in its implementation sites. Participating farmers will be encouraged to adopt effective nonchemical management methods and to apply pesticides only when absolutely necessary.

### 5.1.10 Ethiopia's Ability to Regulate or Control the Distribution, Storage, Use, and Disposal of the Requested Pesticides

The capacity to regulate retail sales, although weak at present, is being strengthened under the directives of the new special decree. The MOA's PRC office is currently focusing its efforts on registering all pesticides that will be imported and sold in the country. It is also training a cadre of inspectors from the regional bureaus, which will be in charge of monitoring pesticide distribution and sales in the regions. Although this cadre of inspectors should improve regulation of pesticide storage and sales at the retail level, their impact has not yet been felt. In contrast,



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no provisions exist for regulation of pesticide use at the farm level, nor are there any requirements for the use of safety equipment (see section 3).

### 5.1.11 Provisions for Pest and Pesticide-management Training of Users and Applicators

Should pesticide use become an option via ERDA, short-term training (seminars and workshops) about pests and pesticide management should be provided to any individual participating in the project who will be involved in the handling, transport, storage, or application of pesticides under ERDA, including project extensionists and zonal office drivers. Input dealers, as well as national and regional inspectors should be encouraged to participate in the courses.

### 5.1.12 Monitoring and Mitigation of Pesticide Use

Responsibility for monitoring pesticide use at the Bako Research Center in ERDA's initial stages and, subsequently, elsewhere, should be assigned to the Bako Research Center, preferably to one individual who has expertise in pest and pesticide management. This person should visit demonstration plots regularly to advise the extensionists on pest and pesticide-management issues and to ensure that suitable pesticide-management practices are being observed and demonstrated to farmers.

If pesticides are to be procured for research or other purposes under ERDA, all aspects of their handling and use should be under the direct supervision of qualified personnel. In addition, the individual who has been assigned responsibility for monitoring pesticides should ensure that the following recommendations and guidelines regarding storage are observed:

> As a general principle, all pesticides must be stored in enclosed, dry, and secure structures, protected from rainfall and extreme heat, and located away from food, feed, and water sources. Storage sheds should not be exposed to flooding and should be identified clearly with a sign bearing the words "DANGER - POISON" in Amharic and English and the universal skull-and-bones danger symbol. Facilities should be locked when not in use.
>
> Pesticides should be stored in their original containers and not repackaged at any time. Empty pesticide containers should be destroyed (crushed or perforated) to prevent their use for other purposes.
>
> Each pesticide container should clearly display its original label indicating, at a minimum, the following information: product trade name, concentration of active materials, toxicity category, directions for use, safety precautions, re-entry statement if applicable, storage and disposal recommendations, and first aid and treatment indications.
>
> Pictorial safety posters, that illustrate and describe safe and appropriate pesticide handling and application practices and the recognition of anticholinesterase (organophosphate and carbamate) pesticide poisoning, should be displayed in strategic areas to assure maximum



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exposure. These should be obtained from the WHO, the MOA, the Ministry of Health, or agrichemical manufacturers.

Additional safety recommendations concerning pesticide use are outlined in section 5.1.8.

## 5.2 Nongovernmental Organizations (NGOs)

The team determined that none of the USAID-supported activities that NGOs implement in Ethiopia involve the use of pesticides for the management of resident pests, directly or indirectly. This conclusion is based on a review of key project documents, an evaluation of NGOs' natural resource activities relative to food aid (Catterson, Buccowich, and Helin, 1994), and interviews with representatives of NGOs and USAID/Ethiopia. Notwithstanding the present situation, given the high profile of SG 2000's activities as well as those of USAID/Ethiopia's NGO Sector Enhancement Project, it is reasonable to assume that other NGOs not presently supported under Title II (see section 5.3 below) may be faced with the possibility of using pesticides under USAID's auspices in the future (Knausenberger, 1995). In such an event, it will be necessary to review and approve the possible use of pesticides in light of USAID's pesticide procedures (Bottrell et al., 1991; USAID, 1991).

## 5.3 Title II Program: Food Assistance and Food for Work

For its humanitarian assistance strategy, USAID/Ethiopia works primarily through cooperating NGOs, using a combination of P.L. 480 regular and emergency resources. The former resources contribute to the stabilization of productive capacity of targeted, vulnerable groups. In fiscal year 1995, this program intended to provide 61,080 mt of commodities through six cooperating NGOs, to support food for work and other development activities, focusing on agricultural soil and water conservation, reforestation, road construction, development of water resources, and agricultural extension. The emergency programs are concentrated in areas affected by shortages of rainfall, drought, and the outbreak of pest infestations, thus resulting in food insecurity. CARE, Catholic Relief Services, and World Vision Relief and Development specifically mention pests as an issue in their emergency programs (USAID, 1995). Title II programs are not normally implemented in the East Wellega area.

USAID's support for the use of pesticides for emergency control of locusts and armyworm in Ethiopia is suitably addressed in the SEA for locust and grasshopper control in Ethiopia (USAID, 1993) and by its 1994 amendment for African armyworms (USAID, 1994). Although the ERDA's Project implementation area in East Wellega is not normally subject to migratory locust infestations, it may experience periodic outbreaks of the African armyworm. In April 1994, the most serious armyworm outbreak ever recorded in the country started in the south, in Teltele *woreda* of Oromia Region, and by May it had spread throughout most of the country. The 1994 SEA amendment recommends the use of carbaryl, malathion, fenitrothion, and chlorpyrifos for armyworm control, as requested by MOA. It further recommends that these pesticides not be stockpiled in country, but that they should rather be provided on an "as needed" basis.



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Several NGOs are involved in agricultural development activity under regular Title II programs. Annex 1 reviews the potential pesticide involvement of these organizations and finds none. The team found no evidence of pesticide use, but this was not verified by field visits. It may be necessary to conduct a more thorough assessment of pertinent NGO activities in relation to possible pesticide use and needs in the future, especially in light of USAID/Ethiopia's NGO Sector Enhancement Project.

## 5.4 Summary and Conclusions

### 5.4.1 Conclusions Relevant to Crop Protection Under ERDA

- Under the 1990 special decree, the MOA's PRC office has initiated a registration process for all pesticides imported and used in the country. The PRC office is also trying to enforce pesticide regulations at the retail level, in collaboration with regional inspectors. The office is seriously understaffed, however, and the regulation and enforcement of pesticide sales at the retail level is inadequate. Ethiopia needs to strengthen its regulatory structure to improve all aspects of pesticide management including safe handling, transport, storage, distribution, sale, use, and disposal.

- Although the MOA has a small analytical laboratory that could be used in support of a quality-control program for pesticides, it lacks the capability to analyze pesticide residues. Analysis of residues is essential to ensure that pesticide residues in agricultural and animal products are within the maximum permissible levels allowed in the country. Similarly, a quality-control program based on random sampling and supported by a qualified laboratory can be an effective deterrent against adulteration or illegal reformulation of pesticides.

- The MOA recommends 14 pesticides for use on maize and wheat. In addition, SG 2000 is promoting the use of Marshal for seed treatment although it has yet to be subjected to in-country validation tests. The USEPA classifies some or all formulations of six of the recommended pesticides (Marshal, endosulfan, Karate, Agoxone, Illoxan, and Gesaprim) are classified as Class I (highly toxic) and/or RUPs. Marshal is not registered for use in the United States.

- Ethiopia's smallholder farmers regularly implement crop-management practices that qualify as cultural IPM techniques. These include complex mixed cropping systems, intercropping, crop rotation, and sanitation. Given the agroecological complexity of this form of agriculture and the limited use of chemical pesticides, most potential insect pests are probably under some form of biological control. Continuing to keep pesticide use to a minimum by applying them selectively and only when absolutely necessary will help to conserve these natural enemies and foster their effectiveness.

- Small-scale farmers using pesticides in maize and areas do not normally use protective equipment during application. Special equipment such as goggles, respirators, and rubber



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gloves and boots are not available in the project area or potential expansion zones. Most would be prohibitively expensive for small-scale farmers, in any case.

- Direct support to the use of pesticides by farmers (e.g., for purchase, application, distribution, etc.) is not expected under ERDA. In contrast, indirect involvement is inevitable. Specific ERDA activities that might involve the use or handling of pesticides include:

  - Providing the East Wellega zonal agricultural office with two pickup trucks, which could be used to transport Marshal (about 500 kg in a single trip) to SG 2000 districts (USAID would not be funding the acquisition of this pesticide);

  - Providing small amounts of pesticide for use on experimental trial plots at the Bako Research Center;

  - Providing pesticide inputs to extension demonstration plots in wheat expansion zones (year five of the project).

  It is not expected that pesticides will be supplied to demonstration plots in the five East Wellega districts that ERDA will support. In two SG 2000 districts that ERDA will support indirectly, USAID will have no involvement in input provision for demonstration plots and no involvement with pesticides, except in the context of limited research plots.

### 5.4.2 Recommendations Pertinent to ERDA

Pesticide Regulation

- Through its policy component, ERDA should seek greater governmental support and commitment of resources to strengthen the implementation of the 1990 special pesticide decree and the MOA's pesticide regulatory capacity, both at the central and regional levels.

ERDA's Involvement with Pesticides

- ERDA should not promote the use of any chemical seed treatment for maize without having first tested its effectiveness for at least two years. Field trials should target the stalk borer and include assessments of crop loss and combinations of chemical and nonchemical approaches to pest management.

- The project should not recommend the use of USEPA Class I (highly toxic) or RUPs. In addition, ERDA should recommend only pesticides needing a minimum amount of protection (long-sleeve shirts, trousers, and footwear). Pesticides requiring the use of special safety gear, such as respirators, safety goggles or face shields, or rubber aprons, gloves, and boots should not be recommended. If pesticides are to be recommended at



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all, their use should be based not only on their demonstrated cost-effectiveness but also on health and environmental considerations.

- Using these criteria, the project should not at present directly support promotion (i.e., demonstration for use by small-scale farmers) of *any* of the chemicals that the MOA currently receommends whether in East Wellega or in potential wheat-expansion zones. Any recommendations made in the future should be based on specific validation and efficacy tests in East Wellega under farmers' conditions. In the case of protection for stored grain, it would be acceptable for project personnel to promote the appropriate use of Actellic, given its relatively low toxicity and USAID's endorsement of its use elsewhere (e.g., in Kenya and Guinea). Any such endorsement must be based on validation by comparative research in Ethiopia. ERDA's workshops on postharvest issues should address this issue.

- ERDA's support for the MOA's extension activities will inevitably result in indirect involvement in the use of pesticides, such as transport using ERDA-funded vehicles. Therefore, appropriate mitigation measures, such as the following, should be implemented:

IPM Promotion and Policy Dialogue

- ERDA should support the adoption of IPM as a country-wide policy and should promote IPM through activities such as workshops, meetings, studies, research, and long- and short-term training in IPM. Policy dialogue with the MOA will also be necessary in order to develop a more consistent approach to demonstration and promotion of chemicals in an IPM framework. To the extent possible, ERDA should support the validation and adoption of nonchemical pest-management alternatives, for both field and stored grain pests.

Training

- Where pesticide use is well established, as in wheat zones, ERDA should incorporate training and technical assistance to farmers in the safe handling and appropriate application of pesticides. Safe pesticide use training is not presently or immediately required in East Wellega due to the extremely low level of use.

- Short-term training in pesticide management should be provided to any individual participating in the project who will be involved in the handling, transport, storage, or application of pesticides, including extensionists and zonal office drivers. Input dealers, as well as national and regional pesticide outlet inspectors should be encouraged to participate in the courses. Special safety precautions concerning the handling and storage of pesticides are provided in section 5.1.7.



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Monitoring

- Responsibilities for project management should be assigned to the research team at the Bako Research Center. One individual, with special expertise in pest and pesticide management at the Bako, should be responsible for monitoring pesticide use in the project's implementation areas. This individual should visit demonstration plots regularly to advise extensionists on pest and pesticide-management issues and to ensure that USAID's Environmental Procedures and appropriate pesticide safety practices are being observed and demonstrated to farmers.

Other longer term priorities for research on IPM are discussed in Annex 9.

## 5.5 NGOs

Under the current conditions in Ethiopia, international NGOs' and Ethiopian private voluntary organizations' use of pesticides is limited. In East Wellega, with the exception of SG 2000, NGOs are not thought likely to use or promote pesticides in the near future. Most NGOs in Ethiopia appear disinclined to use pesticides except as a last resort. This is as it should be. Based on the experience of other NGOs elsewhere in Africa, however, it is reasonable to anticipate the likelihood that a perceived need for pesticides will arise at some point. Before such use is permitted with USAID's funding, appropriate environmental review of such intended use must occur.

## 5.6 Title II Program

Humanitarian NGOs, as the primary implementors of activities related to food aid under the P.L. 480 Title II program, are also likely to encounter the need to deal with crop protection concerns in the event of outbreaks of armyworms or locusts. USAID, the MOA, the NGOs themselves, and the Bako Research Center monitoring unit need to be familiar with and apply the mitigation principles reflected in USAID's SEAs for African armyworms (USAID 1994) and locusts (USAID 1993) in Ethiopia, with respect to the pesticides approved therein. Any use must be preceded by an action plan as described in section 5.2.



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## 6.0 Principal Conclusions and Recommendations

This section summarizes conclusions and makes recommendations relevant to the ERDA program. Principal findings are presented first; a list of recommendations follow.

### 6.1 Main Findings

Based on the team's interviews, field visits, and a review of Ethiopian research literature on pest management the following factors are key to any discussion of smallholders' use of pesticides:

- Pesticide use on small farms is extremely limited. Most imports have in the past been directed to state farms for use on cotton and cereals, while small-scale farmers have constituted an extremely small residual market. With the restructuring of state farms overall demand is declining. Demand among small-scale farmers remains small and narrowly focused on herbicides (for use on wheat and *teff*) in more intensified areas such as Shoa and Arsi zones.

- Small-scale farmers use traditional nonchemical pest-management techniques that in the past have provided some measure of protection against the main field and storage pests for cereals: insects, weeds, diseases, and rodents. These "traditional IPM" methods, which include cultural practices and mechanical controls, should not be displaced or eroded unless better alternatives exist. It may be possible to improve these practices still further through control methods suggested by IPM research.

- The volume of field and storage losses due to pests on small farms in Ethiopia is not known with any accuracy. Loss figures from research experiments of 30 to 50 percent are exaggerated. Such experiments typically take place on-station and do not represent actual small-farmer practices or pest pressures. At best, these figures indicate levels of loss that would be experienced in extreme, worst-case situations.

- Linkages between research on pesticide effectiveness and resulting extension recommendations could be greatly improved. The team has identified one approved maize insecticide, Marshal, for which no research trials have been undertaken in Ethiopia. Improvements in research and extension could improve understanding of the efficacy of pesticides or other individual components of current extension technology packages.

- The legal basis for pesticide regulation lies in a 1990 special pesticide decree. The decree is being strengthened through ongoing work of a National Task Force. The Ethiopian Government's capacity for pesticide regulation, monitoring, and enforcement is extremely weak, and linkages between national institutions and regions need to be articulated and strengthened.

- Important contrasts and similarities exist between reform experiences in the fertilizer and pesticide subsectors. First, the private sector's response to liberalization has been slow in both sectors, due to government policies as well as limitations inherent in markets (see section 4.3.2). Second, the reform of cooperatives has affected demand for fertilizer among smallholders.



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Pesticide demand has not been affected, because pesticides have never been a focus of cooperatives' efforts to supply inputs. Reforms affecting state farms have lowered substantially overall demand for pesticides, but this has not affected small-scale farmers. Third, some government intervention to regulate pesticide and fertilizer marketing is justified. Requirements for regulation of pesticides are greater due to human and environmental costs.

- The public and private sectors' management of pesticides, and physical capacity for handling and storage, are inadequate. In the private sector, handling is particularly problematic at retail levels. Repackaging and adulteration by small-scale traders appears common, due in part to packages that are too large and must be broken down. Labels are in English rather than in the local language, and untrained staff who are not familiar with proper handling and storage methods often handle pesticides.

- ERDA's efforts to develop sustainable input supply systems will assist the emergence of efficient input marketing enterprises dealing in a wide range of agricultural inputs. In East Wellega, such enterprises may not deal in pesticides soon, but efforts to develop markets still have indirect relevance for pesticide marketing. Specifically, when such trade does emerge, general development of input supply systems will provide a stronger basis for efficient pesticide delivery and regulation.

- Analysis in section 4 shows that AISE's prices are below what the market would charge, indicating the presence of implicit subsidies. Other hidden subsidies may well exist for AISE or large private distributors.

- There exist inherent difficulties in monitoring pesticide use and safety for smallholding farmers and small traders. In addition, the infrastructure for dealing with human poisoning or build-up of residues in soil and water is poor.

## 6.2 Recommendations

ERDA is an activity that will aim to increase Ethiopian food production and incomes through two approaches. The first is development of marketing systems for the inputs recommended in the MOA's extension technology packages. The second is refinement of recommendations governing extension packages to fit different farm and agroclimatic conditions.

ERDA's market development interventions involve training of input suppliers, policy conditionalities, and measures to improve policy analysis and supporting data. The overall effect of these activities will be to improve the performance of markets for inputs and to increase farmers' access to package inputs.

ERDA package refinement requires extensive cooperation between research and extension. It embraces three distinct tasks:



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(1) Identification of the most appropriate inputs for extension packages. For example, adjustments must be made regarding fertilizer components (e.g., the relative proportion of urea and diammonium phosphate), seeds (e.g., hybrid seed versus composite versus traditional seed), and pest-management technologies (chemical pesticides versus nonchemical and IPM approaches).

(2) Recommendations on the specific amount, timing, and manner of input application must be refined.

(3) Adaptations in the above recommendations to fit specific soil, climatic, and pest conditions in different locations.

Most, if not all, of the following pest-management recommendations can be accommodated within existing, planned ERDA activities. The scale of suggested activities should be modest. This reflects the relatively small role pesticides have in extension packages, as well as general uncertainty at the research level surrounding the importance of pest problems and the most effective control measures.

**1. Promote IPM as National Policy**

- ERDA should support the adoption of IPM as a national policy. A coordinated approach is required that involves both the extension and research systems. Policy dialogue with the MOA will be necessary in order to develop a more consistent policy on recommendations about and promotion of pesticides. The MOA promotes and demonstrates pesticides only if research has shown a specific chemical to be more effective and economical as compared to nonchemical alternatives. Where possible, ERDA should support the validation and promotion of nonchemical alternatives, for both field and stored grain pests.

**2. Support Improved Pesticide Regulation**

- Through its policy component, ERDA should seek greater government support and commitment of resources to strengthen the implementation of the pesticide decree and the MOA's capacity to regulate pesticides, both at the central and regional levels. One specific conditionality that can be suggested is the requirement that revenues from pesticide registration accrue to the Shola Plant Protection Laboratory.

**3. Support Research and Extension of IPM Approaches**

- ERDA should support adaptive research in IPM at Bako Research Center and research centers in any expansion zones (e.g., Kulumsa for wheat). A number of IPM approaches have been developed but need to be tested, adapted to farm conditions in different localities, and developed into location-specific recommendations. These activities are essential to the task of extension package refinement and also require feedback from extensionists.



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- The extension system should present farmers with IPM alternatives in its demonstration plots. It should modify and improve SG 2000's full-package demonstration approach into a partial package approach. In East Wellega this could involve demonstration of alternative plots with no pesticides, plots demonstrating disease resistant composite seeds or landraces, or other combinations of package elements.

### 4. Train and Organize Input Dealers in Marketing and Safe Handling

- Where pesticide use is relatively well established, as in wheat zones, ERDA should incorporate training and technical assistance to farmers and input dealers in the safe handling and appropriate application of pesticides. Only a small amount of such training is required in East Wellega due to the current lower level of use.

- ERDA should sponsor workshops to train input dealers in the business and technical aspects of pesticide handling and storage. Topics could include demand forecasting, stock management, and the technical aspects of handling and use. Workshops can also support establishment of associations of input dealers. This could involve technical assistance to establish bylaws or to assist in compliance with regulations. Workshops should be used to help identify and train local distribution networks and link them with suppliers in Addis Ababa. Finally, they should be used to identify constraints on private trade that arise from existing regulations or their inefficient enforcement. Measures to eliminate constraints should start with discussions with regional and zonal officials, who should attend workshops, and if necessary, should extend to policy conditionality.

- The proposed SG 2000 Input Market Development Project should, in any anticipated pest-management related activities, focus efforts on improving traders' knowledge of proper pesticide handling, storage, and application. The project should also give emphasis to activities that will increase the supply and marketing of IPM technologies in cooperation with the Bako Rural Technology Center. Finally, the project should explore the possible role of input businesses as financial intermediaries and develop interventions that may, to the extent possible, assist this.

### 5. Charge for the Full Cost of Pesticides

- Subsidies to AISE should be eliminated as part of ERDA's policy conditionality. As a competitive enterprise, AISE should no longer have free use of the MOA's facilities or services or preferential access to cheap credit. AISE should be charged for fixed assets (including vehicles) inherited from government. AISE should also eliminate the implicit subsidies arising from its practice of pan-territorial and pan-seasonal pricing.

- ERDA should consider means to reduce and eventually eliminate distribution of subsidized chemicals for migratory pest control.



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## 6. Monitor Pest Management and Pesticide Use

- Responsibilities for monitoring the safe use of pesticides should be assigned to the research team at the Bako Research Center. One individual, with special expertise in pest and pesticide management at the Bako Station, should be responsible for monitoring pesticide use in the project's implementation areas.

- Monitoring and evaluation of project impact will occur through the Agricultural Economics/Farming Systems Unit at Bako. Planned baseline and follow-up surveys conducted through this unit should be used to monitor pest management and pesticide use at farm level. This will include monitoring of the possible breakdown of traditional farming systems and pest-management practices.

- Data collection supported through the Central Statistical Authority should be used, where possible, to monitor pest management and pesticide use on a broader geographic scale. As with the above monitoring and evaluation surveys, monitoring should be limited to a few essential indicators in order to minimize data requirements.



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## References


Abt Associates. 1995. Ethiopian Agricultural Policy and Information Systems: Assessment and Recommendations. Addis Ababa, Ethiopia: USAID.

ACDI/CEE. 1995. Rural Finance and Microenterprise Needs Assessment for Ethiopia. Addis Ababa, Ethiopia: USAID.

Addis Ababa Chamber of Commerce. 1992. Demand Study for Agricultural Chemicals. Addis Ababa, Ethiopia: Chamber of Commerce.

Agridec. 1995. "The Production Component of the ERDA Project: Draft Final Report." Addis Ababa, Ethiopia: USAID. (Photocopy, USAID/Ethiopia files).

Altieri, M. 1995. Biodiversity and Pest Management in Agroecosystems. New York: Food Products Press.

Aredo, Dejene. 1993a. "The Iddir: A Study of an Indigenous Informal Financial Institution in Ethiopia" 1(17) Centre for Financial Assistance to African Countries.

_____. 1993b. The Informal and Semi-formal Financial Sectors in Ethiopia: a Study of the Iqqub, Iddir, and Savings and Credit Cooperatives. African Economic Research Consortium Research (AERC) Paper No. 23. Nairobi, Kenya: AERC.

Arnold, E. 1992. The BMA Guide to Pesticides, Chemicals and Health. London, U.K.: Edward Arnold.

Assefa, Habtu. 1995. "Status of Disease and Disease Management in Wheat and Maize: Background Paper Commissioned for USAID Pesticide Review." Addis Ababa, Ethiopia: USAID.

Bottrell, Dale G., J. Bruce Mann, Patricia C. Matteson, Myron D. Shenk, Allen Steinhauer, and Paul S. Teng. 1991. How to Prepare Environmental Assessments of Pesticide Use in A.I.D. Agricultural Projects. College Park, MD: Consortium for International Crop Protection.

Cargill Technical Services. 1994. Ethiopia Cotton Sector Assessment. Washington, D.C.: Cargill Technical Services.

Catterson, T. M., M. Buccowich, and W. Helin. 1994. Natural Resources Management and Title II Food Aid: An Evaluation. Addis Ababa, Ethiopia: USAID/Ethiopia.

Chiche, Y. 1995. "A Review of Literature on Weeds in Ethiopian Cereal Crops: Background Paper Commissioned for USAID Pesticide Review." Addis Ababa, Ethiopia: USAID.




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CIMMYT. 1988. From Agronomic Data to Farmer Recommendations: An Economics Training Manual. Mexico City, Mexico: CIMMYT.

Debele, Anbessie. n.d. "Procedures in Obtaining Agricultural Business Licenses." (Photocopy, USAID/Ethiopia files.)

Derso, Fessehaye. 1995. A Brief Report on Pesticide Registration Activities in Ethiopia. Addis Ababa, Ethiopia: Agricultural Development and Crop Protection Department, MOA.

East Wellega Planning and Economic Development Office, Zonal Task Force. n.d. Summary of the Identification and Assessment of Resource Base Conservation Strategy of E. Wellega: Volume II. East Wellega, Ethiopia: East Wellega Planning and Economic Development Office.

Farah, Jumanah. 1994. Pesticide Policies in Developing Countries: Do They Encourage Excessive Use? World Bank Discussion Paper No. 238. Washington, D.C.: World Bank.

Gavian, S. and Gemechu Degefa. 1994. "Commercial Investors and Access to Land: Paper Presented to the Workshop on Land Tenure and Land Policy in Ethiopia after the Derg." Addis Ababa, Ethiopia: ILRI.

Gebre-Mariam, Hailu et al. 1991. Wheat Research in Ethiopia: A Historical Perspective. Addis Ababa, Ethiopia: IAR and CIMMYT.

Gordon, Henry. 1995. ERDA Financial and Economic Analysis. Addis Ababa: USAID.

Gordon, H., Habtemariam Abate, and Kiflu Bedane (Cropping System and Area Selection Team). 1995. An Analysis of Food Crop Production, Productivity and Marketing in Ethiopia. Addis Ababa, Ethiopia: USAID.

International Fertilizer Development Center. 1993. Ethiopia Fertilizer and Transport Sector Assessment. Addis Ababa, Ethiopia: USAID.

International Monetary Fund. Ethiopia: Economic Developments Various issues.

Knausenberger, Walter I. 1995. "Scoping Statement: Environmental and Economic Review of Agricultural Crop Protection Interventions and Inputs in Ethiopia." Addis Ababa, Ethiopia: USAID/Ethiopia and USAID/Bureau for Africa.

Knausenberger, Walter I. and Stryk Thomas. 1993. "Provisional Environmental Guidelines for PVO/NGO Field Use in Africa: Sound Environmental Design for Integrated Relief and Development Planning and Project Implementation." Washington, D.C: Bureau for Africa, USAID.



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Laketch, Michael and Tadele Selaisse. 1995. "Draft Institutional Analysis for ERDA." Addis Ababa, Ethiopia: USAID.

Matteson, P. and M. Meltzer. 1994a. Environmental Implications of Agricultural Trade and Promotion Policies in Cameroon: Pest and Pesticide Management. Arlington, VA: Winrock International Environmental Alliance, Environmental and Natural Resources Policy and Training Project (EPAT).

_____. 1994b. Environmental and Economic Implications of Agricultural Trade and Promotion Policies in Kenya: Pest and Pesticide Management. Arlington, VA: Winrock International Environmental Alliance, EPAT.

Meltzer, M., P. Matteson, and W. Knausenberger. 1994. Environmental and Economic Implications of Agricultural Trade and Promotion Policies in Uganda: Pest and Pesticide Management. Arlington, VA: Winrock International Environmental Alliance, EPAT.

Ministry of Finance, Government of Ethiopia. 1995. "Ethiopia: Summary of the Tax System as at the End of December 1994." Addis Ababa, Ethiopia: Ministry of Finance. (Photocopy.)

Sasakawa Global 2000. 1995. "Proposal for the Initiation of a Pilot Private Agricultural Inputs Retail Business Promotion Project." Addis Ababa, Ethiopia: SG 2000.

Stroud, Ann. 1989. Weed Management in Ethiopia: an Extension and Training Manual.

Szmedra, Philip. 1994. Pesticides and the Agrichemical Industry in Sub-Saharan Africa. Arlington, VA: Winrock International Environmental Alliance, EPAT.

Tadesse, E. 1994. "State Farms and Emerging Private Farms." Paper for 4th Annual Conference on the Ethiopian Economy. Debre Zeit, Ethiopia: Ethiopian Economic Association.

Tadesse, S. n.d. "Procedures Associated in Obtaining Business License and Bank Loan for Agricultural Venture by the Private Sector." (Photocopy, USAID/Ethiopia files)

Tanner, Douglas ed. 1994. Developing Sustainable Wheat Production Systems The 8th Regional Wheat Workshop. Addis Ababa, Ethiopia: CIMMYT.

Tilahun, Bekele. 1994. "Rural Credit in Ethiopia." Paper for 4th Annual Conference on the Ethiopian Economy. Debre Zeit, Ethiopia: Ethiopian Economic Association.

Tolessa, Benti and Joel K. Ransom, eds. 1992. Proceedings of the First National Maize Workshop of Ethiopia. Addis Ababa, Ethiopia: IAR and CIMMYT.



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Transitional Government of Ethiopia. 1994. National Conservation Strategy Volume IV: Action Plan for National Policy and Volume V: A Compilation of Projects. Addis Ababa, Ethiopia: Transitional Government of Ethiopia.

USAID. 1991. Pest Management Guidelines of the Agency for International Development. Washington, D.C.: USAID.

_____. 1992. "Program Assistance Approval Document: USAID Support to Ethiopia for Development of Competitive Markets." Addis Ababa, Ethiopia: USAID. (Photocopy, USAID/Ethiopia files.)

_____. 1993. "Supplementary Environmental Assessment for Locust and Grasshopper Control in Ethiopia." Washington, D.C.: USAID.

_____. 1994. "Environmental Impact Assessment of African Armyworm Control in Ethiopia: An Amendment to the Supplemental Environmental Assessment of Locust/Grasshopper Control in Ethiopia." Washington, D.C.: USAID.

_____. 1995a. "USAID Humanitarian Assistance and Situation Report FY 1995." Addis Ababa, Ethiopia: USAID. (Photocopy, USAID/Ethiopia files.)

_____. 1995b. "ERDA Project Paper: Draft August 9, 1995." Addis Ababa, Ethiopia: USAID. (Photocopy, USAID/Ethiopia files.)

Yerga, Chilot. 1993. "Factors Influencing the Adoption Decision and Rate of Adoption of New Wheat Technologies in the Wolmera and Addis Alem Areas of Ethiopia" M.A. Thesis, Alemaya University.



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## Annex 1: Potential Pesticide Involvement of Title II NGOs

This annex gives a brief summary of agricultural development activities undertaken by NGOs associated with USAID under its Title II program. The main source used is Catterson, Buccowich, and Helin (1994). Other sources are indicated below.

### Ethiopian Orthodox Church: Ginager, N Shoa project

Most emphasis is on food for work activities aimed at road construction, seedlings, terraces. "Most recently, vegetable production demonstration" in FY 94 (no pesticide use is mentioned). Approximately 7,000 Food for Work beneficiaries are targeted out of 37,000 *woreda* residents. Project support has ended (Michael Harvey, personal communication). Pesticide involvement is not an issue because the project has ended.

### Relief Society of Tigrai

In 1992 Title II activities began and now serve seven districts, through the Integrated Agricultural Development Program. Food programs are provided for the society's programs though Catholic Relief Services. This amount has been over 4,000 mt per year in recent years. Agricultural extension and seed banks (provision of improved seed) are two of the seven activities mentioned. In one site visited there were vegetable demonstration plots. The project document, "Relief Society of Tigray, Northern Ethiopia: PL 480 Title II DPP: FY 1996-1998," April, 1995 describes the following activities: training of farmers, provision of vegetable seeds, fruit seedlings, grass and fodder seeds, hand tools, seed multiplication, irrigation pumps. This project has no apparent pesticide involvement.

### World Vision

The Kilte Awlaelo Areas Development Program operates in two *woredas* in Tigrai, one of which is supported by Title II. This support began in 1992. The activity involves the construction of earthen dams.

The Omosheleko Agricultural Development Program, started in 1991, operates in 22 of 31 peasant associations of the *woreda*. Activities are Food for Work type bund building, seedling production, and maintenance of feeder roads. This project has no apparent pesticide involvement.

### CARE

Food for Work activities in E. Haraghe started in 1993 and operate in six *woredas* (18 peasant associations). Primary activities are soil and water conservation, i.e., bund building, dams, ponds and wells, seedling nurseries, and tree planting. Coffee seedlings are produced in Food for Work-run nurseries. In addition, some extension support is given to selected Model Villages, for example for tomatoes. No pesticides are mentioned as part of latter activities.



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See Project Document "CARE ETHIOPIA, MultiYear Operational Plan FY 1995-1999" June, 1994 (USAID files). Page 13 notes that Food for Work-supported activities include construction and/or rehabilitation of roads, dams, soil conservation structures and buildings. No pesticide involvement is apparent.

According to the document, CARE Ethiopia will be involved in some pesticide-related activities, which are not supported by USAID's Title II program. These include "The provision of agricultural inputs (seeds, tools, fertilizer and pesticides) on a cash and credit basis." Subsidies on input price and credit are apparent. CARE directly manages input delivery. Other activities that do not mention pesticides but may involve them include extension support for vegetable production and support for improvements in grain storage.

Discussion with Michael Rewald of CARE Ethiopia clarified the situation. While the project document does mention pesticides as one possible agricultural input, CARE Ethiopia does not now, and will not in the future provide or be involved with handling of pesticides for nonmigratory pests. CARE now has a strict pesticide policy and a decision has been made not to be involved with pesticides, despite the project document's descriptions. This project has no pesticide involvement whatsoever, and none is anticipated in the future.

**Food for the Hungry**

The Alaba Conservation-Afforestation Project is in the Kembata-Albaba-Tembaro Zone in Southern Region. Regular USAID Title II food aid started in 1986. This is one of the longest running NGO projects funded by Title II food aid. As the name implies it deals with reforestation. The project has no apparent pesticide involvement.

**Catholic Relief Services**

This project operates in Guraghe zone in Southern Region. The activities involve reforestation, soil and water conservation, and feeder road rehabilitation. The project has no apparent pesticide involvement.



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## Annex 2: Additional Research Results on Diseases and Weed Problems for Maize and Wheat

### Maize diseases

Leaf blight is abundantly found especially in wet and humid regions. A recent survey estimated that the average infection by this disease in commercial and smallholder farms is approximately 38 percent and up to 27 percent, respectively. It is suggested that the high incidence of the disease in commercial farms may be due to a continuous monoculture and the wider use of hybrids.

A yield loss of 10 to 50 percent has been reported due to leaf blight; yield loss depends on the season, level of resistance of cultivars, and time of infection.

Common rust is an important disease in the lower altitudes (1,550-2,000 m). It occurs periodically causing some heavy yield losses in some years. Occasional heavy infection is common in the low altitudes such as the Awassa, the Bako and the Nazareth areas. A two-year yield loss study at Bako showed a 25-percent loss under artificial infection and a 23-percent loss under national infection, but there were varietal differences.

MSV was reported from low to mid altitude humid regions. The virus is particularly prevalent in mid altitudes and humid conditions such as Abobo, Gambella. The highest incidence (20 to 25 percent) is recorded from Abobo, Gambella, Western Ethiopia. In recent times the disease was observed in eastern Ethiopia, where maize is grown extensively. A 15-20 percent incidence was recorded around Bako and Didessa. Improved varieties, poorly managed fields, and late sown maize crops suffer heavy damage by MSV. Data on crop loss are not available in Ethiopia, but it is estimated that under severe infection, total crop failure can occur.

### Wheat diseases

Stem rust is found under a wide range of environmental conditions; it is reported from Shewa, Arsi, Sidamo, Bale, Wellega and Hararghe. But stem rust population increases rapidly and causes heavy damage in wheat at altitude ranges of 1,800-2,200 m, with day temperatures of around 25°C. Under Ambo conditions, yield loss due to stem rust averaged 52 percent in a susceptible variety. In Arsi, yield varied between 2,290 kg/ha and 3,680 kg/ha due to differences in treatments of stem rust using fungicides, especially in the susceptible variety. A study of yield losses by the Chilalo Agricultural DevelopmentUnit (in 1973) found a loss of 14 q/ha from stem rust infection on a susceptible cultivar.

Overall, the distribution and severity of leaf rust is generally moderate. It is observed in almost all wheat growing areas but it is known to be less damaging than stem rust. Leaf rust is endemic to most areas and can occur together with both stem and stripe rusts.



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Stripe rust is found in Shewa, Wellega, Gojjam, Gonder, Arsi, and Bale. Stripe rust is mainly, though not exclusively, a disease of the cooler climates, especially in the high altitudes (above 2,400 m) of Arsi and Bale. In a high epidemic year commercial varieties such as Dashen are severely infected at higher altitudes. The highest incidence of stripe rust is normally found at Meraro (2,980 m) and Bekoji (2,760 m) in Arsi. Stripe rust is more severe in commercial farms than in traditional farmers' fields.

Results of yield loss trials carried out in 1982-83 for stripe and leaf rusts at Dixis, Meraro, Gofer and Sheneka (in Arsi and Bale) suggest that a yield loss of 43 percent and 63 percent occurs at infection levels of 10.4 to 16.0 percent. In a field experiment conducted at Holetta in 1968-69 a yield loss of 96 percent was recorded for stripe rust, 75 percent for leaf rust, and 61 percent for stem rust.

Septoria diseases of wheat are often reported as the second most important diseases to rusts. They are widely distributed in Ethiopia. Two species of septoria, leaf blotch (*Septoria tritici*) and glume blotch (*Septoria nodorum*) are the most prevalent; septoria leaf blotch is the more damaging of the two in Ethiopia.

A yield loss of 25 percent was estimated with a high level of septoria infection, especially on dwarf Mexican varieties at Debre Zeit. In a field experiment conducted in Holetta a yield loss of 82 percent and seed weight loss of up to 30 percent due to septoria leaf blotch were reported.

The two most important smut diseases in Ethiopia are the bunt or stinking smut (*Tilletia caries* and *Tilletia foetida)* and the loose smut (*Ustilago tritici*). Bunt causes considerable damage in areas above 2400 m. Wheat bunt causes damage mainly in farmers' fields. Occurrence of bunt in wheat was first reported in Ethiopia in 1937. It has also been reported from Kaffa. Bunt infection is now widespread and can be found in farmers' fields of Tigrai, Wello, Gojjam, Wellega, Shewa, Arsi, Sidamo, Bale, and Gamo Goffa. The highest incidence is found in Bichena (Gojjam) and in Meti, Sheno, and Tefki (Shewa). Yield loss caused by bunt was estimated at about 5 percent for the nation in severity ranges of 5 to 20 percent.

A countrywide survey on foot rot diseases of wheat suggests that eye-spot (caused by *Pseudocercosporella herpotrichoides)* is most widespread in Ethiopia. Eye-spot is generally a disease found mainly in cool highlands. It is favored by high soil moisture, dense crop canopy, and high humidity. A preliminary study of yield losses due to eye-spot on wheat indicated that losses ranging from 1 to 29 percent could occur depending on the cultivar's resistance.



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**Annex 2, Table 1: Guide to Herbicides Used in Maize**

| Herbicide | Dose[a] | Crop stage | Weed stage | Weeds controlled |
|---|---|---|---|---|
| alachlor (Lasso 480 EC) | 5.0 | pre-emergence | pre-emergence | annual grasses; some broadleaf |
| alachlor + atrazine (Lasso/atrazine 350 + 200 FW) | 6.0 | pre-emergence | pre-emergence | annual grasses and broadleaf weeds but not *Rottboellia* |
| atrazine + metolachlor (Primagram 250 + 250 FW) | 4.0 | pre-emergence | pre-emergence | annual grasses and broadleaf weeds; *Rottboellia* resistant |
| atrazine + metolachlor (Primextra 200 + 300 FW) | 4.0 | pre-emergence | pre-emergence | same as above; less residue problems and greater grass control |
| cyanazine + atrazine (Blazine 250 + 250 FW) | 6.0 | pre-emergence | pre-emergence | broadleaf weeds and some annual grasses but not *Rottboellia* |
| 2,4-D (720 EC) | 1.0 | post-emergence | post-emergence | many annual broadleaf weeds; toxic to some maize cultivars |

[a] Dose refers to amount of product administered.

Source: adapted from Stroud (1989).



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## Annex 2, Table 2: Herbicide Recommendations for Wheat

| Herbicide | Dose[a] | Crop stage | Weed stage | Weeds controlled |
|---|---|---|---|---|
| barban (Carbyne 25 EC) | 8.0 | post-emergence | post-emergence | only wild oats |
| bentazone (Basagran 480 EC) | 2-3.5 | post-emergence | post-emergence | annual broadleaf weeds |
| bromoxynil + MCPA (Buctril M 400 EC + Brominal Plus 525 EC) | 1.4<br>1.2 | post-emergence | post-emergence | annual broadleaf weeds |
| bromoxynil + ioxynil + mecoprop (CMPP) (Brittox 525 EC) | 2.0-2.5 | post-emergence | post-emergence | annual broadleaf weeds |
| chlortoluron (Dicuran 500 FW or 800 WP) | 3.0-5.0<br>1.8-3.1 | pre-emergence | pre-emergence | annual grasses and broadleaf weeds |
| diclorprop (2,4-D) (U-46 DP- Fluid 620 EC) | 2.5-4.0 | post-emergence | post-emergence | broadleaf weeds |
| diclofop methyl (Illoxan 360 EC) | 2.5 | post-emergence | post-emergence | annual grasses (including wild oats & Lolium) |
| difenzoquat (Avenge 250 EC) | 3.2-4.8 | post-emergence | post-emergence | wild oats |
| flamprop isopropyl L (Suffix BW 200 EC) | 3.0 | post-emergence | post-emergence | wild oats |
| MCPA (U-46 M-Fluid 625 EC) | 1.9 | post-emergence | post-emergence | broadleaf weeds |

[a] Dose refers to amount of product administered.

Source: adapted from Stroud (1989).



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**Annex 3:** **Forms for Registration and Description of Labelling Requirements from the MOA's Pesticides Registration and Control Office**

## APPLICATION FOR PESTICIDE REGISTRATION

(To be submitted in duplicates)

FOR OFFICIAL USE

Application No._____
Date Received_____
Fees Receipt No._____
Date of Analysis_____
Date Reviewed_____
Date Approved/Rej._____
Registration No._____
Certificate No._____
Expiry Date_____
Rej. Letter Ref. No._____

Pesticides Registration
and Control Office
P.O. Box 62347
Addis Ababa, Ethiopia

1. NAME OF REGISTRANT: _____
2. ADDRESS OF REGISTRANT :_____
3. TRADE LICENSE NO.:_____
4. BRAND NAME OF THE PESTICIDE: _____
5. COMMON NAME OF THE PESTICIDE: _____
6. % ACTIVE INGREDIENT AND FORMULATION: _____
7. NAME AND ADDRESS OF ACTIVE INGREDIENT MANUFACTURER: _____

   _____
8. PLACE OF ACTIVE INGREDIENT MANUFACTURE: _____
9. NAME AND ADDRESS OF THE PESTICIDE FORMULATOR: _____

   _____

   _____
10. USE CATEGORY: INSECTICIDE _____ HERBICIDE _____

    FUNGICIDE _____ RODENTICIDE _____

    OTHERS (SPECIFY) _____

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11. PROPOSED USE: (USE ADDITIONAL SHEETS IF NECESSARY)

| CROP(S) | PESTS(S) | RATE (AI/HA) | RATE (PRODUCT/HA) |
|---|---|---|---|
| _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ |

12. PACKING SIZE, TYPE AND SPECIFICATION: _____

_____

_____

13. SAMPLES OF THE PESTICIDE SUBMITTED: _____

FORMULATED PRODUCT_____

ACTIVE INGREDIENT:

~~TECHNICAL GRADE~~: _____

LABORATORY GRADE: _____

14. <u>ENCLOSURE</u>

14.1 AGENCY AGREEMENT

14.2 MANUFACTURING LICENSE IN THE COUNTRY OF ORIGIN

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## DATA REQUIREMENTS

All current information available, both published and unpublished, should be supplied according to the layout suggested herewith. References should be given against each summary data submitted. Data should be submitted in bound form, properly indexed according to the information required.

### A. SPECIFICATION

1. Active ingredient (identify)

   a. Common name accepted by ISO
   b. Chemical name (IUPAC)
   c. Empirical formula and molecular weight
   d. Structural formula

2. Physical and chemical properties of active ingredient

   a. Appearance (physical state, color, odor)
   b. Melting point (If solid at room temperature)
   c. Boiling point (if liquid at room temp.)
   d. Vapor pressure (at 20 - 25 C)
   e. Density
   f. Solubility in water and organic solvents
   g. Partition Coefficient (if organic and non-polar)
   h. Stability under different conditions: in water, in organic solvents, light, etc.

3. Formulation (General Information)
   a. Brand name
   b. Type of formulation
   c. Appearance (physical state, color, odor)
   d. Detailed composition: active ingredient content; main impurities; solvents; other components
   e. Acidity/alkalinity (where relevant)
   f. Flammability
   g. Moisture content

4. Physical and chemical properties of the formulated product

   a. Density (for liquids)
   b. Sieve test (for powders); particle size (for granules or dust)
   c. Suspensibility or emulsifiability characteristics (where relevant)
   d. Wettability
   e. Flash point or other indicator of flammability (if formulation contains combustible liquid)
   f. Compatibility/incompatibility with other pesticide products

5. Method of formulation analysis, preferably according to CIPAC

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6. Storage stability at different temperatures and relative humidity over 3 years.

7. Batch certificate of analysis:

   (a) Name & address of laboratory
   (b) Date of analysis (attach certificate of analysis)

8. Cite major publications on specifications of the product.

## B. EFFICACY

Efficacy trials are normally done on typical formulations. In general, efficacy data should be generated locally, however, in official emergency situations, they may be extrapolated from similar crops and pest situations in other countries or from similar formulations.

1. Intended uses and methods of application

   a. Mode of action (effects on pests)
   b. Types of pests controlled and/or types of crops, materials or premises to be protected, be it for agriculture or non-agricultural use
   c. Rate of application
   d. Number and time of application (season or stage of growth)
   e. Method of application (high volume, ULV, fumigation, etc.)
   f. Phytotoxicity; necessary waiting periods to avoid phytotoxic effects.

2. Experimental data

   a. Results of laboratory studies, if any
   b. Experimental data generated by recognized and independent local organization
   c. Recommendations on pests controlled in specific crops
   d. Effects on beneficial or non-target organisms
   e. Comparison with reference method or normally accepted practice
   f. Advantages of the product or its manner of use which may compensate for any deficiencies.
   g. Phytotoxic effects

3. Cite major publications on efficacy tests of the product.

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## C. TOXICOLOGY

Submissions should include date of study, institution involved, and comprehensive summary of completed toxicological reports. Requirements may also be satisfied by citing appropriate reviews of relevant toxicological data from other regulatory bodies, or providing results of international reviews by organizations such as WHO/IPCS, IRPTC, or WHO/FAO, JMPR.

1. Toxicity of the formulated product

   a. Acute oral LD50 (Study in rat - calculation permissible from active ingredient, in some cases)
   b. Acute dermal LD50 (Study in rabbit - calculation permissible from active ingredient, in some cases)
   c. Inhalation LC50 (Required only if pesticide has high vapor pressure or if used as a gas, smoke, fog, fumigant, or contains respirable dust.)
   d. Skin irritancy (unabraded skin - rabbit)
   e. Eye irritancy (rabbit - Not required if pH is less than 3 or greater than 11.5; or if corrosive to skin)
   f. WHO classification
   g. Allergenicity of the product

2. Toxicity Studies on the Active Ingredient

   a. Acute oral LD50 (study in rat)
   b. Acute dermal LD50 (study in rabbit)
   c. Inhalation LC50 (see 1c)
   d. Skin irritancy (unabraded skin - rabbit)
   e. Eye irritancy (rabbit - not required if pH less than 3 or more than 11.5, or if corrosive to skin
   f. Subchronic toxicity, oral LD50 (90 days) studies in rodents - two species for food crops, one for non-food crops)
   g. Subchronic toxicity, dermal LD50 (21 days - study in rodent)

3. Supplementary Toxicological Studies (Active Ingredient)

   a. Chronic toxicity (lifetime in rat)
   b. Carcinogenicity (lifetime in rat and mouse) (may be combined with chronic test)
   c. Reproduction studies (2-generation rat or rabbit studies)
   d. Teratogenicity (studies in rabbit and rat)
   e. Mutagenicity (multi - battery tests, including in vivo mammalian tests)
   f. Neurotoxicity (hens - normally only if cholinesterase inhibition is expected)

4. Observation on Man, if any

   a. Direct observations, e.g. clinical cases
   b. Health records, both from manufacturers and agriculture

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5. Information on Diagnosis and Treatment

   a. Signs and symptoms of poisoning
   b. First aid procedures
   c. Medical treatment for poisonings, antidote if any
   d. Proposed Acceptable Daily Intake (ADI) (Calculated - for food uses only)
   e. Recommended precaution in handling the product
   f. Recommended treatment after exposure
   g. Safety interval between treatment of crop or animal and harvest/consumption in both temperate and tropical climate.

6. Cite major publications on toxicological tests effect of the product.

## D. ENVIRONMENTAL EFFECTS

1. Soil

   a. Analytical procedures for residues in soil
   b. Leaching
   c. Degradation in soil
   d. Effects on soil organisms

2. Water

   a. Analytical procedures for residues in water
   b. Degradation in water, including residues
   c. Absorption and binding to organic matter in water
   d. Effects on aquatic habitat

3. Toxicity Data

   a. Toxicity to birds (suitable species - pigeon, quail, pheasant, duck, or Bengalese finch; test in one species for typical formulation)
   b. Toxicity to fish (96 hr. test in one species for a.i., suitable species: rainbow trout, zebra fish, fat head winnow, etc.)
   c. Toxicity to bees, if available

4. Information on beneficial insects other than bees e.g. parasites or predators, if available.

5. Cite major publications on environmental effects of the product.

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## E. RESIDUES ON FOOD

1. Identity of principal residues, metabolites and degradation products in edible crops, foods or feeds
2. Residue decay curves on treated crops.
3. Residues and principal metabolites in animals fed treated feeds or grazed on treated fields (feeds or pasture use only).
4. Effects of food processing on residues (for foods processed before eating).
5. Analytical methods for detection of principal residues, metabolites on treated commodities.
6. Proposed maximum residue limit for each crop, food, feed, animal expected to contain residues.
7. Pre-harvest interval or waiting period.
8. Major publications on the residue of the product in different items (food, feed, soil, water, etc.)

## F. LABELS

1. Six copies of the specimen or an exact of the labels as it appears on the pesticide container.

2. The script should be written in both Amharic and English and shall contain the following.

   a. The brand name of the pesticide
   b. Hazard description according to WHO
   c. Common name of the active ingredient
   d. Batch identity No
   e. Direction for use
   f. Safety interval
   g. First aid advice
   h. Date of manufacture
   i. Method of disposal of the pesticide and empty package

## G. OTHERS

1. Disposal of unusable pesticides and containers under practical condition for developing countries.
2. Enclose specimen of any extra information or pamphlets usually distributed to users of the pesticide product.

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## LABELLING REQUIREMENTS

The content and format of the label when registering a pesticide in Ethiopia is stated as follows:

I. CONTENT

A. LABEL CONTENT - What is in the container must be clearly indicated

- common name
- trade name
- chemical name (IUPAC)
- type of formulation
- active ingredient content
- net content of the pack
- category of pesticide (insecticide...)
- inert materials, solvents (type, ratio...)

B. SAFETY INFORMATION

- product specific advice
- relevant protective clothing
- precautions during and after application
- environmental safety during and after application
- safe storage
- safe disposal of product and used container
- how to clean equipment
- safety pictograms (all required)
- warning "Keep locked up and out of reach of children"....)
- first aid advice and Medical Treatment (Note to physician)

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C. INSTRUCTIONS FOR USE

- type of pest, type of crop.. where to use the product, area, target..
- how, when and where the product can be legally used with maximum efficiency
- how to mix and apply; the rate of use
- timing of frequency and period of crop
- any limitations (susceptible crops, weather...)
- compatibility with other products
- how to avoid harming beneficial insects

D. OTHER INFORMATION

- local distributor's name
- registration number
- manufacturer's name and company logo
- date of manufacture, shelf life
- batch number (identification number)

II. LABEL LAYOUT - It is suggested that THREE PANEL LAYOUT be used. Contents in each panel must be as indicated on the attached format. However, ONE PANEL LAYOUT may be used when space is too small (0.5 - 2 lts/kgs)

III. COLOUR CODE

- Text on label should be mainly black on a plain white background
- band colour according to WHO classification (see below)
- hazard statement and hazard symbol same as above.

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| WHO Hazard Class | Hazard Statement | Band Colour | Hazard symbol |
|---|---|---|---|
| 1a<br>Extremely hazardous | Very toxic | Red | Skull and Bone |
| 1b<br>Highly hazardous | Toxic | Red | Skull and Bone |
| II<br>Moderately hazardous | Harmful | Yellow | ☒ |
| III<br>Slightly hazardous | Caution | Blue | - |
| IV<br>Product unlikely to present a hazard in normal use | - | Green | - |

Hazard Warning Symbol - Registrants may choose only the required symbols except the hazard symbol which is a must. Symbol indicated on panel contains the following colour.

| | COLOUR | |
|---|---|---|
| Type | Symbol | Background |
| Corrosive | Black | White |
| Explosive | " | " |
| Flammable liquid | " | Red |
| " solid | " | White |
| Water reactive/release flammable gas | " | Blue |
| Highly flammable | " | White/red ½ upper, ½ lower) |
| Irritant | " | Yellow or orange |
| Oxidizing | " | " " " |

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IV. Pictograms

- positioned label bottom (≥ 15% of height)
- used in 4 combinations with the following order

---

1. storage 2. activity Hazard symbol at center 3. advice 4. warning

---

V. Amharic - English

- when THREE PANEL LAYOUT is used, each language should have its own complete label;
- when space is too small and ONE PANEL LAYOUT is used, both language can be set side by side on the same label with common colour band at the bottom;
- translations must convey the same meaning (content and pictograms)

VI. Quality of Material

- strong enough to avoid tearing during transport and handling
- durable to withstand storage (ink & adhesive)
- coated to resist wetting and smudging of text

VII. Print size

It is recommended that all safety text should be at least 8 - points, and that all other text should be at least 6 - point. The preferred size is 11 - point (FAO).

VIII. Label size

Registrants must present label of actual size and type which will be affixed on the container or containers depending on size they want to register i.e. 1 lt, 2 lt, 25 lt, 200 lt label types.

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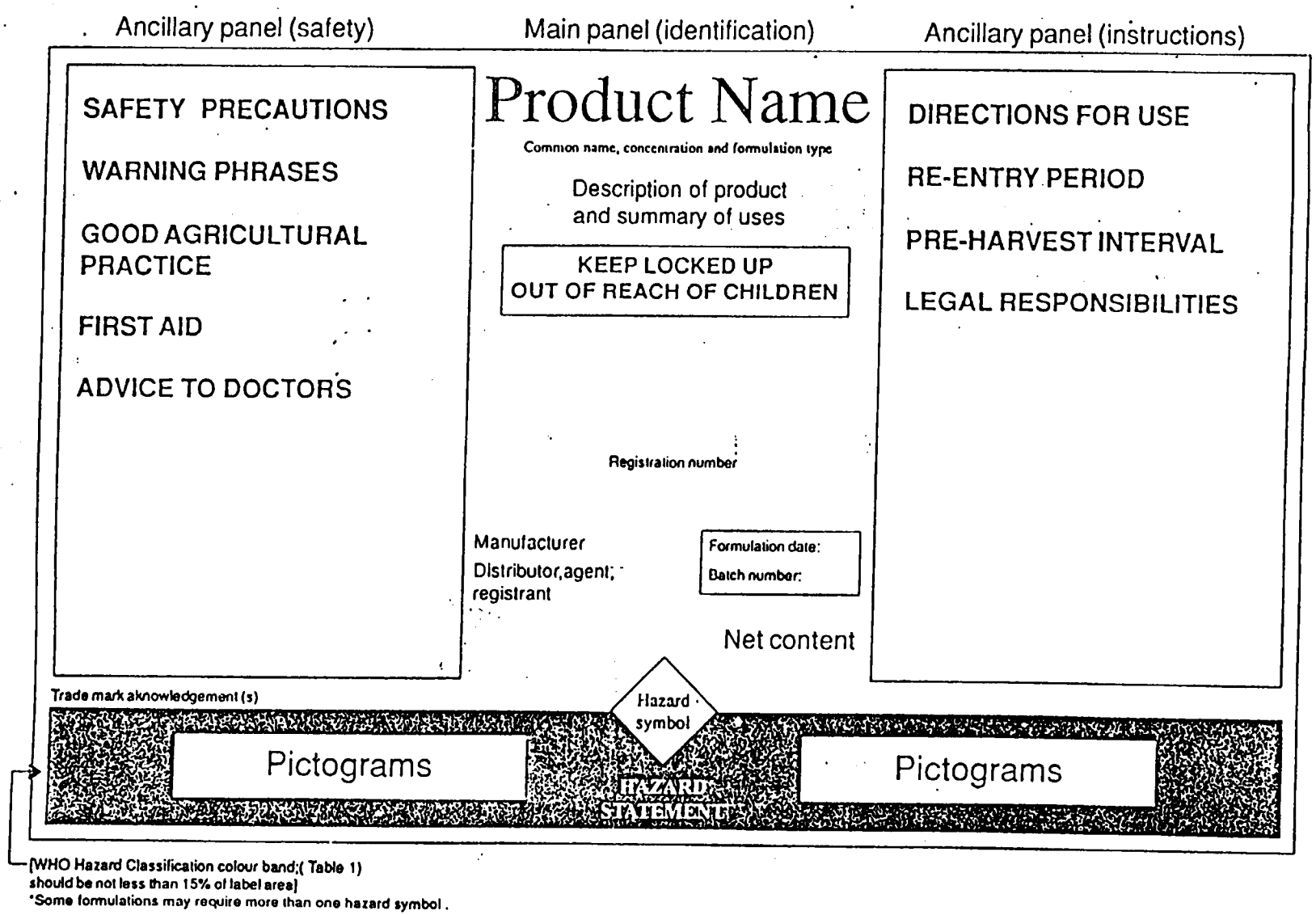


A three panel label

## Annex 4: Pesticide Import and Use Data

### Table 1: Volume of Pesticide Imports (mt)

| Year | Insecticides | Herbicides | Fungicides | Disinfectants | Total |
|---|---|---|---|---|---|
| 1983 | 3,279 | 17 | 3 | 20 | 3,319 |
| 1984 | 2,298 | 51 | 476 | 121 | 2,946 |
| 1985 | 1,702 | 9 | 364 | 416 | 2,491 |
| 1986 | 3,285 | 345 | 100 | .03 | 3,730 |
| 1987 | 5,498 | 118 | 2 | .36 | 5,618 |
| 1988 | 2,290 | 55 | 2 | na | 2,347 |
| 1989 | 2,668 | 6,681 | 21 | na | 9,370 |
| 1990 | 6,276 | 312 | 21 | na | 6,609 |
| 1991 | 439 | 34 | 0 | na | 473 |
| 1992 | 1,411 | 111 | 36 | na | 1,558 |
| 1993 | 1,181 | 2,827 | 54 | na | 4,062 |
| 1994[a] | 744 | 148 | 41 | na | 933 |

[a] first six months only.

Source: data from Customs Department files.



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**Annex 4, Table 2: Value of Pesticide Imports (million $)**

| Year | Insecti-cides | Herbi-cides | Fungi-cides | Rodenti-cides | Total |
|---|---|---|---|---|---|
| 1978 | 14.29 | 2.74 | 0.00 | 0.00 | 17.03 |
| 1979 | 3.87 | 3.39 | 1.26 | 0.07 | 8.59 |
| 1980 | 6.72 | 1.07 | 0.55 | 0.30 | 8.64 |
| 1981 | 10.31 | 0.15 | 1.56 | 0.02 | 12.04 |
| 1982 | 5.31 | 0.02 | 0.15 | 0.00 | 5.48 |
| 1983 | 10.22 | 0.08 | 0.02 | 0.00 | 10.32 |
| 1984 | 12.40 | 0.14 | 0.86 | 0.11 | 13.51 |
| 1985 | 6.00 | 0.03 | 1.74 | 0.00 | 7.77 |
| 1986 | 13.98 | 0.94 | 0.23 | 0.00 | 15.15 |
| 1987 | 24.21 | 0.65 | 0.01 | 0.00 | 24.87 |
| 1988 | 25.06 | 0.64 | 0.01 | 0.00 | 25.71 |
| 1989 | 28.49 | 6.40 | 0.18 | na | 35.08 |
| 1990 | 28.02 | 3.94 | 0.19 | 0.26 | 32.41 |
| 1991 | 5.42 | 0.72 | 0.01 | na | 6.15 |
| 1992 | 18.63 | 1.21 | 0.15 | na | 19.99 |
| 1993 | 11.35 | 13.70 | 4.02 | na | 29.07 |
| 1994[a] | 22.32 | 7.40 | 1.13 | na | 30.85 |
| Avg. (excl 1994) | 14.02 | 2.24 | 0.68 | 0.06 | 16.99 |

[a] first six months only.

Source: data from Customs Department files



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**Annex 4, Table 3: Summary of AISCO's Pesticide Imports (000 kg or l)**

| Year | Insecticides | Herbicides | Fungicides | Rodenticides | Total |
|---|---|---|---|---|---|
| 1987-88 | 1,116 | 200 | 194 | 4 | 1,514 |
| 1988-89 | 22 | 41 | 49 | 16 | 129 |
| 1989-90 | 408 | 76 | 6 | 0 | 490 |
| 1990-91 | 176 | 0 | 0 | 0 | 176 |
| 1991-92 | 339 | 147 | 0 | 0 | 486 |
| 1992-93 | 9 | 335 | 3 | 0 | 348 |
| 1993-94 | 859 | 280 | 5 | 20 | 1,164 |
| 1994-95 | 814 | 128 | 260 | 10 | 1,212 |
| Average | 468 | 151 | 64 | 6 | |

Note: one liter is roughly equivalent to one kilogram.

Source: AISCO files.

**Annex 4, Table 4: Summary of State Farms' Use of Pesticides (000 kg or l)**

| Year | Insecticides | Herbicides | Fungicides | Rodenticides | Total |
|---|---|---|---|---|---|
| 1987-88 | 1,145 | 455 | 122 | 14 | 1,738 |
| 1988-89 | 1,339 | 270 | 120 | 2 | 1,733 |
| 1989-90 | 797 | 351 | 61 | 12 | 1,222 |
| 1990-91 | 917 | 289 | 36 | 20 | 1,263 |
| 1991-92 | 509 | 151 | 130 | 0 | 790 |
| 1992-93 | na | na | na | na | na |
| 1993-94 | 93 | 147 | 47 | 0 | 289 |
| 1994-95 | na | na | na | na | na |

Notes: one liter is roughly equivalent to one kilogram. Numbers may not add due to rounding.

Source: AISCO files.



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## Annex 5: Notes on Use of Pesticides for Malaria Vector Control

Information from an interview with Ato Tarekegn Abose, Head of Malaria and Vector Disease Control Program, Ministry of Health, Addis Ababa.

### Chemicals Used by the Malaria and Vector Disease Control Program

- DDT 75% is the chemical of choice. It is applied in selected areas and is sprayed inside houses ("residual spraying"). The main season is June-July.

- Resistance to DDT develops slowly and at present there are few areas of resistance. Where resistance exists, malathion 50% is also used for inside house spraying.

- The larvicide temefos is also used to an extent and is applied in breeding sites.

### Program Imports

- The Ethiopian Government purchases vector control chemicals through the government budget. Donors do not provide grants.

Imports in 1995 include:

450 mt of DDT 75%
4 mt of DDT 100%
20 mt of malathion 50%
(there are stocks of temefos which will be used)

Imports in 1994 were:

400 mt of DDT 75%
3 mt of DDT 100%
no malathion
no temefos

All DDT imported each year is fully used. There is never enough to meet the need perceived by the Vector Control Unit, and all stocks are used each year. The main program constraints are: lack of chemicals, staff, transport, equipment (general low resource availability).

### Nonchemical Alternatives to Malaria Control

- Environmental control of breeding places. Tigrai has a well-organized community control system organized via peasant associations. In the past decade such systems existed in other regions but fell apart. The New Health Strategy focuses on primary rural health care delivery.



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- Impregnated bed nets. This approach is slow to start. The reasons for this are as follows. First, bed nets are not used traditionally, except in Gambela. Second, this approach has not been promoted because the effectiveness of nets is doubted in Ethiopia's highly seasonal malaria environment. Bed nets have not been promoted as policy. "More research" is thought to be needed, and there has only been one study to date, in Southern Ethiopia (not released). It was noted that in the Gambia when the government began to charge for nets, use fell off.

The instability of malaria seasons is cited as a problem. Not only is the onset date uncertain but there is little immunity because of the seasonality of the disease - it comes and goes. People forget to use nets during each new transmission season.

In each region there are vector control staff under the malaria control unit. They train village members in spraying (one week course). Sprayers are paid.

There is a little donor support, e.g., from WHO (equipment). No NGOs work on this program in the field.

The unit uses the following manual: Guidelines for Malaria Control Program in Ethiopia (September 1983), MInistry of Health. This describes:

- preparation of concentrations
- precautions in pesticide application
- special instructions to squad chiefs
- sprayer training curriculum (six days)



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**Annex 6: Large-scale Commercial Farm Enterprises Receiving Permission to Lease Land in East Wellega**

| Name of Owner(s) or Enterprise | Hectarage Acquired[a] | Woreda Location |
|---|---|---|
| Miraf Enterprise | 1,500 | Dabo Hana |
| Ato Gabisa Mawara | 100 | Diga |
| Ato Marga Gurmu | 50 | Abe Dangoro |
| Ato Marga Gurmu and others | 350 | " |
| Ato Barsisa Sambata | 50 | Guduru |
| Ato Dabala Gana'a | 50 | Sibu Sire |
| Ato Dawud Muhamed | 500 | Waya Tuk |
| Gada Enterprise | 6,500 | Sasiga |
| Dine Gudina Enterprise | 5,300 | Gida Kiremu |
| Ato Olana Gobana and Mustafa Abdul | 350 | " |
| Ato Tashele Tucho | 3,500 | " |
| Ato Tabala Kumsa, Gabayo Tarafa, Tabala Benti, and Anger Company | 5,000 | Abe Dangoro |
| Melka Enterprise | 3,500 | Sasiga |
| Total | 26,750 | |

[a] The land acquired is actually hired or leased from government. Not all of the hectarage is cultivated at present.

Source: East Wellega Zonal Agricultural Bureau, Nekemte.



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## Annex 7: Pesticide Prices

### Table 1: Pesticide Prices (AISCO) and Food Price Index

| Year | 2,4-D Herb-icide for Wheat birr/l | % in-crease | Endosulfan 35% Insec-ticide for maize & sorghum birr/l | % in-crease | Actellic 2% Storage insec-ticide maize & sorghum birr/kg | % in-crease | Food Price Index | % in-crease |
|---|---|---|---|---|---|---|---|---|
| 1988 | 14.00 | | 11.00 | | 6.00 | | | |
| 1989 | 14.45 | 3 | 11.60 | 5 | 6.20 | 3 | 1.00 | |
| 1990 | 17.00 | 18 | na | na | 6.50 | 5 | 1.04 | 4% |
| 1991 | 22.00 | 29 | 22.25 | na | 9.00 | 38 | 1.12 | 8% |
| 1992 | 25.00 | 14 | 31.10 | 40 | 9.90 | 10 | 1.53 | 36% |
| 1993 | 31.20 | 25 | 44.40 | 43 | 17.85 | 80 | 1.75 | 15% |
| 1994 | 34.65 | 11 | 49.30 | 11 | 19.80 | 11 | 1.75 | 0% |
| 1995 | 46.60 | 34 | 49.15 | 0 | 23.60 | 19 | 2.07 | 18% |

**Sources: Prices for 2,4-D, endosulfan, and Actellic from AISE (formerly AISCO) files. Source for food price index is cpi data originating from National Bank of Ethiopia.**



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**Annex 7, Table 2: Marshal: Calculation of Import Parity Price and Implicit Subsidy in AISE Pri (Financial Values)**

| Cost Items | Costs | |
|---|---|---|
| | Local component | Foreign exchange component |
| c&f $/320 g | 9.00 | |
| Size of smallest pack | 80 grams | |
| Application rate/ha | | |
| c&f Price Birr/320 g[a] | | 56.52 |
| Ocean insurance (2% cif) | | 1.13 |
| cif price Birr/320 g | | 57.65 |
| Commission/bank charges (4.5% on c&f) | 2.54 | |
| Import duty (15% of 101% cif) | 8.73 | |
| Sales tax (12% of previous row) | 8.04 | |
| Handling/clearing charges (5.4% of cif) | 3.11 | |
| Transport to Addis Ababa: 830 kms[b] | 0.04 | 0.01 |
| Loading/unloading Assab-Addis Ababa[c] | 0.01 | |
| Contingency (10% of cif) | 2.00 | |
| Overhead (5% of cif) | 2.88 | |
| 6 months' interest before sale (7% on bank charges plus cif) | 4.21 | |
| 1 month's interest (1.2% on bank charges, duty transport) | 0.26 | |
| Importer's margin (20% of cif) | 11.53 | |
| Transport/handling to Nekemte: 330 kms | 0.01 | 0.00 |
| Loading/unloading Addis Ababa-Nekemte | 0.01 | |
| Wholesalers' margin (5% of cif) | 2.88 | |
| Retailers' margin (2.5% of cif) | 1.44 | |
| Final Import Parity Retail Price | 105.38 | |
| SG 2000 sale price to farmer | 80.00 | |
| Parity Price/Sale Price | 1.32 | |

Note: Numbers may not add due to rounding. c&f = cost of freight; cif = cost of insurance and freight.

[a] All entries below here in birr/q.
[b] @ .14 birr per km.
[c] loading rate for 20 mt truck: 3 birr/q.



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## Annex 7, Table 3: Marshal: Calculation of Import Parity Price and Implicit Subsidy in AISE Price (Economic Values)

| Cost Item | Cost | |
|---|---|---|
| | Local component | Foreign exchange component |
| $/320 g | 9.00 | |
| Size of smallest pack | 80 grams | |
| Application rate/ha | 320 grams | |
| c&f Price Birr/320 g[a] | | 71.10 |
| Ocean insurance (2% cif) | | 1.42 |
| cif price B/320 g | | 72.52 |
| Commission/bank charges (4.5% on c&f) | 3.20 | |
| Import duty (15% of 101% cif) | 0.00 | |
| Sales tax (12% of previous row + cif) | 0.00 | |
| Handling/Clearing charges (5.4% of cif) | 3.92 | |
| Transport to Addis Ababa: 830 kms[b] | 0.04 | 0.01 |
| Loading/unloading Assab-Addis Ababa[c] | 0.01 | |
| Contingency (10% of cif) | 7.25 | |
| Overhead (5% of cif) | 3.63 | |
| 6 months' interest before sale (7% on bank charges and cif) | 5.30 | |
| 1 month's interest (1.2% on bank charges, transport) | 0.08 | |
| Importer's margin (20% of cif) | 14.50 | |
| Transport/handling to Nekemte: 300 kms | 0.01 | 0.01 |
| Loading/unloading Addis Ababa-Nekemte | 0.01 | |
| Wholesalers' margin (5% of cif) | 3.63 | |
| Retailers' margin (2.5% of cif) | 1.81 | |
| Final Import Parity Retail Price | 115.94 | |
| SG 2000 sale price to farmer | 80.00 | |
| Parity Price/Sale Price | 1.45 | |

Note: Numbers may not add due to rounding. c&f = cost of freight; cif = cost of insurance and freight.

[a] All entries below here in birr/q.
[b] @ .14 birr per km.
[c] loading rate for 20 mt truck: 3 birr/q.



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## Annex 8: Research Results on the Efficacy of Pesticides

**Table 1: Efficacy of Insecticides for the Control of Maize Weevil in Stored Maize at Awassa** (1985-86)

| Treatment | Rate (ppm) | Infested seed (%) | Seed wt loss (%) |
|---|---|---|---|
| Pirimiphos methyl (Actellic) | 7.0 | 4.4 | 1.9 |
| Methacrifos (Dampfin) | 7.0 | 4.5 | 2.4 |
| Gamma-HCH (Lindane) | 15.0 | 5.9 | 5.5 |
| Fenitrothion (Sumithion) | 7.5 | 4.7 | 6.9 |
| Deltamethrin (Decis) | 1.0 | 5.9 | 13.4 |
| Check (untreated) | - | 92.7 | 16.5 |

Rate = dose of active ingredient.

Source: adapted from A. Tadesse et al. in Tolessa and Ransom (1992).

**Table 2: Effect of Fungicides on Leaf and Stripe Rusts at Arsi and Bale (1982 and 1983)**

| Treatment | Yield (q/ha)[a] | Increase (%)[a] | Yield (q/ha)[b] | Increase (%)[b] |
|---|---|---|---|---|
| Check (untreated) | 18.8 | - | 15.9 | - |
| Propiconazole | 28.8 | 53.1 | 23.5 | 47.8 |
| Triadimefon | 26.0 | 38.2 | 20.6 | 29.6 |
| Bordeaux + maneb | 17.9 | -5.0 | 14.7 | -7.5 |
| Fenpropimorph | 25.7 | 36.6 | 19.0 | 19.5 |
| Oxycarboxin | 21.6 | 14.8 | 17.9 | 12.6 |
| Prochloraz | 22.4 | 19.1 | 19.2 | 20.9 |
| Tridemorph | 25.1 | 33.5 | 20.5 | 28.9 |

Note: doese are in cited documents.

[a] leaf rust (at Sheneka).
[b] stripe rust (at Goffer).

Source: adapted from Assefa (1995).



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**Table 3: Comparison of Handweeding and Herbicide Treatment (2,4-D or MCPA) in Bread Whea Arsi Area**

| Treatment | Grain yield (kg/ha)[a] | Grain yield (kg/ha)[b] | Increase (%) |
|---|---|---|---|
| Unweeded vs 1 Handweeding | 2,130 | 2,640 | 23.9 |
| Unweeded vs MCPA | 2,100 | 2,430 | 15.7 |
| Unweeded vs 2,4-D | 2,100 | 2,400 | 14.3 |
| 1 Handweeding vs MCPA | 2,630 | 2,410 | -8.4 |
| Unweeded vs Early spraying with MCPA (<25 days post emergence) | 1,760 | 2,330 | 32.4 |
| Unweeded vs Late spraying with MCPA (>25 days post emergence) | 2,030 | 2,310 | 13.8 |

[a] Base treatment.
[b] Upper treatment.

Source: Gebre-Mariam et al. (1991), The Chilalo Agricultural Development Unit conducted the trials.



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## Annex 9: Longer Term Priorities for an IPM Program

The program priorities enumerated below relate to development of an IPM program from scratch. Both for the ERDA project areas and for most other crops and regions in Ethiopia, there is adequate information on the various IPM components ready to be tested on a large scale and implemented within the project duration. Of course, this will not obviate the need for further research to develop IPM programs or to fine tune the existing information.

### Establishing significance of pests and diseases

Currently available information on yield losses caused by pests and diseases is inadequate. Accurate information on yield losses and hence on the significance of pests and diseases is essential so that uneconomic pest-management practices are avoided.

Emphasis needs to be given to determining crop losses on farmers' fields. Thus, a network of on-farm trials strategically located to represent a range of normal farm practices in the ERDA project area should be developed.

Pest and disease numbers and the damage they cause to crops vary from season to season. These factors along with the change in farm practices suggest that loss assessment trials should be conducted for two to three years and updated at given intervals, depending on the rate of change in crop production practices.

The responsibility for conducting loss-estimate trials must rest with research organizations, in collaboration with extension services and development organizations. Trials should follow a multidisciplinary approach involving crop protection staff, agronomists, soils experts, and socioeconomists.

### Development of IPM Programs

The objective situation of the agricultural environment of Ethiopia dictates that IPM should be adopted as the national policy for agricultural research and development. The ever-soaring cost of pesticides, their unavailability, the lack of smallholder pesticide know-how, coupled with potential environmental hazards and danger to human safety, make it impractical for subsistence farmers to rely heavily on pesticides for pest management.

Development and implementation of IPM programs in Ethiopian agriculture should be a high priority approach. The major components of an IPM program should consist of information on cultural practices, natural biological control, host-plant resistance, and the use of safe, selective, and environmentally friendly pesticides, including botanicals and synthetic insecticides. Steps in developing an IPM program are detailed as follows:

### Determining the influence of cultural practices on pests and diseases

Cultural practices (such as the sowing date, plant density, intercropping, and crop husbandry) play an important role in determining the pest and natural enemy numbers and disease incidence. Studies on cultural



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practices can be conducted on major pests and diseases at strategic locations and must involve expertise in crop protection, agronomy, and soil fertility.

**Determining population dynamics of major pests and their natural enemies**

Thorough knowledge of seasonal changes in populations of pests and natural enemies and the ecological factors associated with these changes is one of the key elements in the development of a sound IPM program. Studies must be initiated to implement experiments on population dynamics at selected sites of major pest species. This may involve use of pest-monitoring devices such as light traps, pheromone traps, or simple sampling-and-counting techniques, depending on the nature of the pest species in question. Weekly, biweekly, or monthly samples can be collected for two to three years.

**Exploration of biological control agents**

Biological control is one area of research on crop protection that has not received much attention in Ethiopia although a few unsuccessful attempts were made to introduce natural enemies against a few pests and weeds. Work relating the abundance of natural enemies with different cropping patterns and diversity of habitats is essential to devise techniques that will encourage and conserve natural enemies.

**Screening for host-plant resistance**

Host-plant resistance is extensively used in the IPM of many important crop pests and diseases in many parts of the world. Normally this will involve introduction and testing of large amounts of germplasm from national and international programs, but at present there are sources of resistance already identified by research institutions in the country.

Developing host-plant resistance in crop varieties should involve the combined efforts of plant pathologists, entomologists, and breeders.

**Screening of pesticides**

Pesticides will play an important role in pest management for some time to come. However, it is essential that safe and environmentally friendly pesticides be screened and tested on a large-scale before they are put to general use. Pesticides to be tested will include synthetic chemicals, botanicals, insect growth regulators and microbials.

**Implementing IPM programs**

The results of studies enumerated above will have to be integrated to implement a workable IPM program. This can be achieved through on-farm testing of the technologies developed in an integrated manner. Extension staff need to be given training at the implementation stage of IPM. In turn they can train farmers (in collaboration with research staff).



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**Human resource development**

Both short- and long-term training is anticipated for human resource development. Researchers, technicians, extension staff, and farmers need to be trained in the short term. Degree training for specialized fields in IPM can be introduced (MSc. and Ph.D.).



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## Annex 10: People and Organizations Contacted

### Government, Including Agricultural Extension Service

Dr. Bateno Kabeto, Head, MOA Agricultural Development and Crop Protection Division, Addis Ababa
Mr. Karnisa, Head of Crop Protection, Oromia Regional Office, Addis Ababa
Fessehaye Derso, PRC office, Agricultural Development and Crop Protection Department, MOA, Addis Ababa
Dr. Samuel, Head Plant Protection, Oromia Agricultural Bureau, Addis Ababa
Mr. Margetsuni, Team Leader Plant Protection, Oromia Agricultural Bureau, Addis Ababa
Habtemariam Abate, Extension Expert, MOA, Addis Ababa
Demsa Angosha, Head, Plant Protection, MOA Nekemte, East Wellega Zone
Tarekegn Abose, head of Malaria and Vector Disease Control Program, Ministry of Health, Addis Ababa
Wolde Tsadik Someno, Head, Import Licensing Division, Ministry of Trade, Addis Ababa
Mekete Wube, Statistics Unit, Customs Department, Addis Ababa
Beekata Qana, District Extension Head, Sibu Sire *woreda*, East Wellega Zone
Fiyera Milkessa, Economic Research Division, National Bank of Ethiopia, Addis Ababa
Tsegaye Ayano, Extension Supervisor and acting SG 2000 representative, Arsi Negele *woreda*, E. Shoa zone
Lecha Liben, Crop Protection Team Leader, Awassa, Sidamo zone
Assaye Lemma, Crop Protection Expert, Awassa, Sidamo zone
Dr. Habtamu Degife, Head of Zonal Extension Bureau, Shashemene *woreda*, E. Shoa zone
Gebre-Yohannes Estifanos, Agrononist and Extension Expert, Shashemene *woreda*, E. Shoa zone
Dr. Tewolde Berhan, Director, National Environmental Protection Agency, Addis Ababa

### Research

Research staff, Melkassa (Nazareth) Research Center, Nazareth, Ethiopia
Bekele Geleta, Central Manager, Kulumsa Research Center
Ayele Badebu, Agricultural Economist, IAR, Kulumsa Research Station
Abraham Tadesse, Entomologist, Crop Protection Division, Bako Research Station, Bako, W. Shoa
Dr. Fakede Abebe, Phytopathologist, Crop Protection Division, Bako, W. Shoa
Ferdisa Edja, Entomologist, Crop Protection Division, Bako, W. Shoa
Mr. Isola, Director, Bako Rural Technology Center, Bako, W. Shoa
Dr. Wilfred Mwangi, Economist, CIMMYT, Addis Ababa
Dr. Sara Gavian, ILRI, Addis Ababa

### Private Sector

Afework Tadesse, AgrEvo, Horn of Africa PLC, Addis Ababa (distributor for Hoechst/Shering)
Mengistu Kebede, Head of Agricultural Inputs Unit, Ethiopia Amalgamated Ltd., Addis Ababa
Mr. Marcos, General Chemicals and Trading Company, Addis Ababa (distributor for ICI)
Tekaligne Abate, Head of Planning and Trade Promotion, Ethiopia Chamber of Commerce, Addis Ababa
Management staff, Adami Tulu Reformulation Plant, Adami Tulu, Ethiopia
Mr. Begasho, EthioPest Control, Addis Ababa (interviewed by telephone)



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Selected pesticide retailers and wholesalers in the administrative zones of Arsi, W. Shoa, East Wellega, E. Shoa, and Sidamo.

**Parastatals and Restructuring Public Sector Organizations**

Getachew Tedhin, Managing Director, ESE, Addis Ababa
Mr. Belisa, Head of Sales and Distribution Department, AISE (formerly AISCO), Addis Ababa
Management staff, EGTE, Addis Ababa
Geletaw Mekonnen, AETSE, Addis Ababa

**NGOs**

Takele Gebre, SG 2000, Addis Ababa
Staff of Makana Jesus, East Wellega (involved in agricultural extension)
Mr. Michael Rewald, CARE, Addis Ababa

**Donors**

Mr. Minoru Yoshimura, Assistant Resident Representative, JICA, Addis Ababa
Mr. Sisay, FAO office, Addis Ababa
Mike Harvey, Head of Title II Office, USAID, Addis Ababa
Peter Riley, Head of Development of Competitive Markets (DCM) Project, USAID, Addis Ababa
Ashton Douglass, USAID, Addis Ababa, interviewed in connection with upcoming USAID NGO Enhancement Project



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